

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Group for
Sustainability and Technology

Prof. Dr. Volker Hoffmann
www.SusTec.ethz.ch

An Introduction to the EU ETS and the CDM

Zurich, August 9, 2010

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

BRIEF HISTORY OF INTERNATIONAL CLIMATE POLICY

1992	United Nations Framework Convention on Climate Change UNFCCC, agreed on during Rio Summit
1997	<p>Kyoto Protocol:</p> <ul style="list-style-type: none"> • Emission targets for industrialized countries • No targets for developing countries, but incentives for reductions on the basis of the Clean Development Mechanism (CDM)
2001	Marrakesh Accords which set the rules for Flexible Mechanisms
2005	Kyoto Protocol entered into force
2005	<ul style="list-style-type: none"> • 11th Conference of the Parties COP, 1st Meeting of the Parties MOP • Start of Post 2012 process • EU emission trading started

PRELIMINARY GOAL AND FUTURE NECESSITY

Goal of Kyoto Protocol

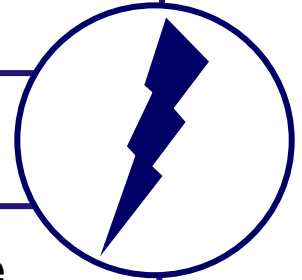
Reduction of 5.2% of Greenhouse Gas (GHG) emissions

- Based on the level of CO₂-equivalent emissions in 1990 levels caused by 6 GHGs (CO₂ just one of them)
- Compliance period is 2008 to 2012, i.e. the emission reductions need to be accomplished at the latest in 2012

Future necessity

Kyoto Protocol will not suffice to stabilize world temperature

EU Council of environment ministers announced in 2005 that a „...*reduction pathways by the group of developed countries in the order of 15-30% by 2020 and 60-80% by 2050 compared to the base line envisaged in the Kyoto Protocol should be considered.*”



To accomplish the Kyoto goal, the industrialized countries agreed on different national targets

BACKUP

KYOTO TARGETS, EMISSION DEVELOPMENTS AND SHARE OF CO₂ EMISSIONS

Country	Goal 2008/12 based on 1990 (in %)	Change until 2001/2002 (in %)	Share on CO ₂ -emission (in %) of industrialized countries*
EU 15	- 8	- 2,9	24,2
New EU MS and candidates **	- 8	- 36,0	8,0
Russia	0	-36,4	17,4
Switzerland	- 8	- 1,7	0,3
Japan	- 6	+ 7,6	8,5
Canada	- 6	+ 20,1	3,3
USA***	- 7	+ 13,1	36,1
Australia***	+ 8	+ 22,0	2,1

How did new EU member states and Russia achieve such strong reductions?

* Referring to emissions of industrialized (incl. transition) countries in 1990

** Poland and Hungary: - 6 %

*** Kyoto Protocol not ratified by country

But although targets were negotiated individually most countries are not on track to meet them

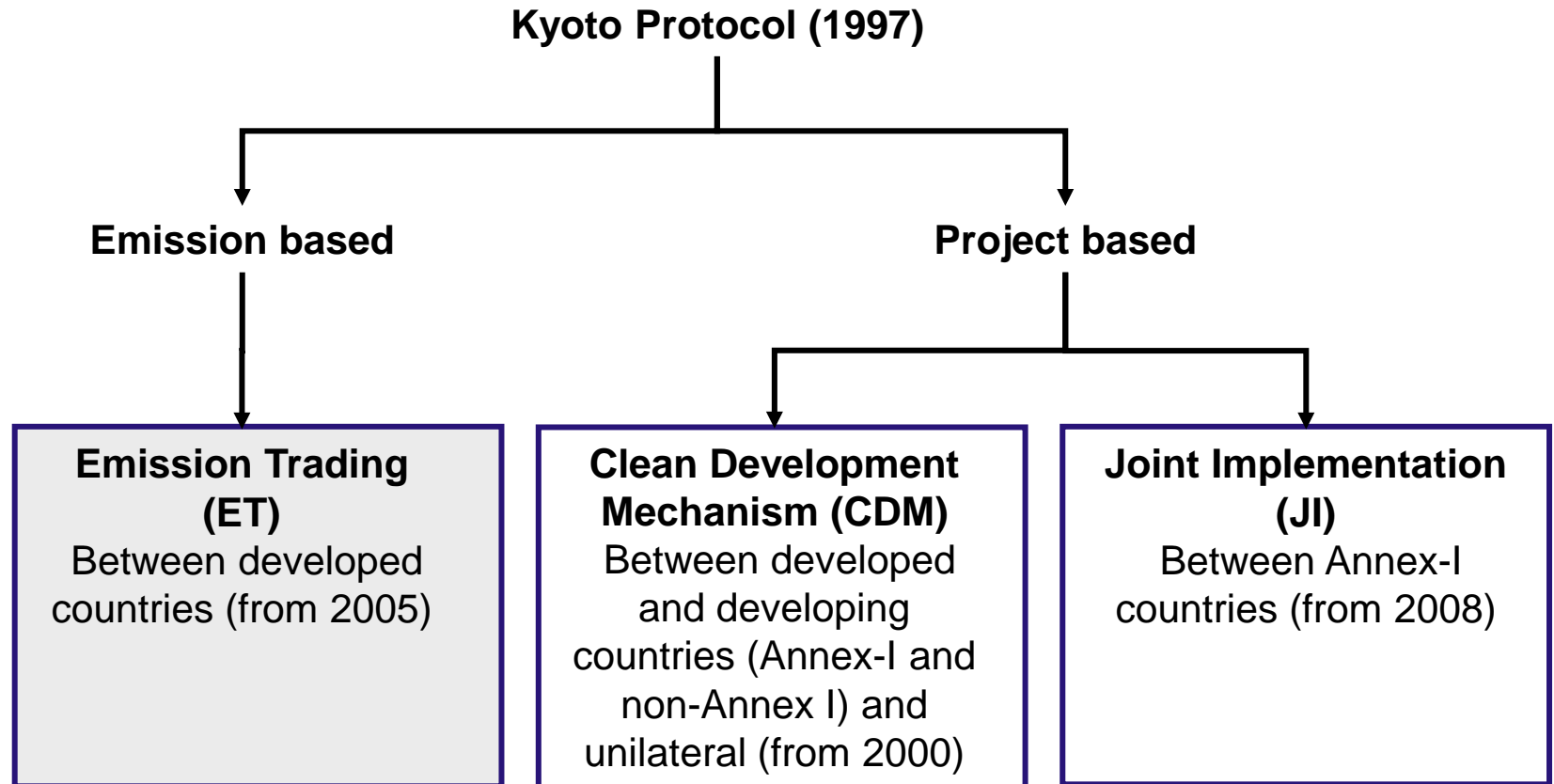
BACKUP

ACHIEVEMENT OF COUNTRY EMISSION TARGETS

- The EU uses the principle of burden sharing:
 - Some countries are allowed to emit more than in 1990 (e.g. Spain, Greece and Portugal) and
 - Others have to reduce much more than the EU goal of -8% (e.g. Germany with -21%)
- Most countries currently seem to have difficulties to achieve their targets (more than half of the EU countries not on track)

In order to help countries in achieving the targets in a cost-efficient way the Kyoto Protocol proposes three flexible mechanisms

OVERVIEW OF EMISSION REDUCTION INSTRUMENTS

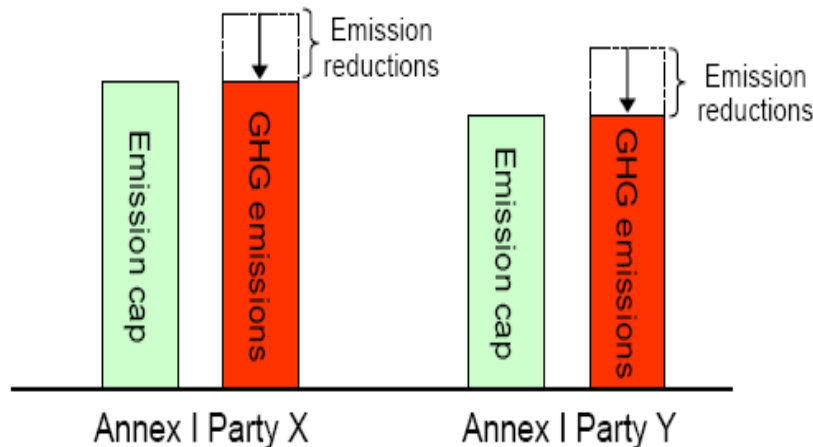


The main instrument is the International Emission Trading between so-called Annex-I countries

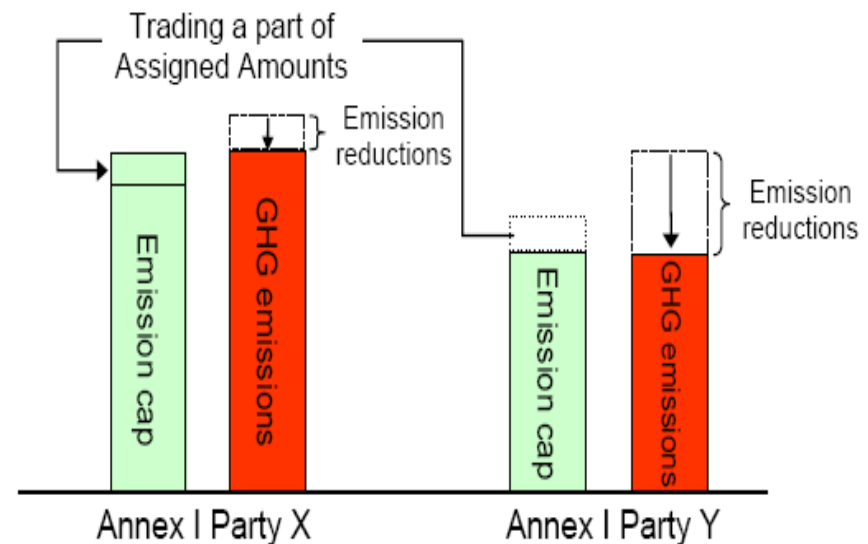
GOAL AND FUNCTIONING OF THE INTERNATIONAL EMISSION TRADING

- **Problem:** Emissions in developed countries are too high
- **Goal 1:** To allow parties to achieve their targets in a cost-efficient way
- **Goal 2:** To promote global innovation in low carbon technologies
- **Functioning:** Countries with low reduction costs will reduce and sell their surplus emission certificates to those countries with higher reduction costs

Without International Emissions Trading



With International Emissions Trading



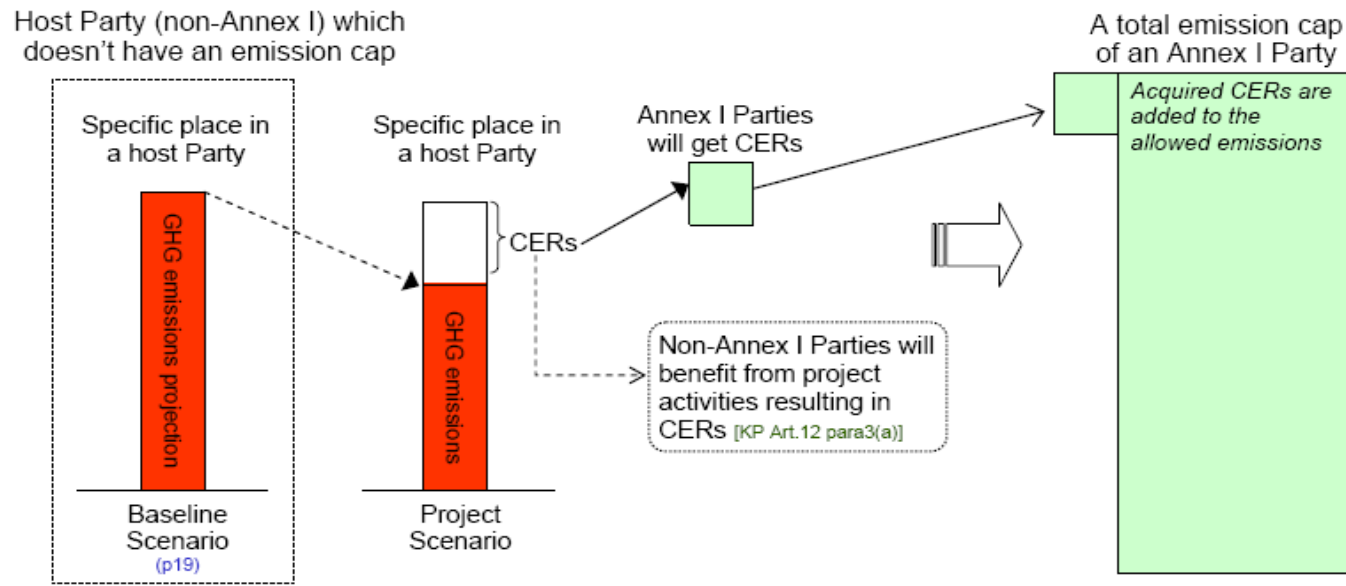
Source: CDM and JI in charts (version 6), IGES (2006)

The CDM aims at achieving both cost-efficient emission reductions and at contributing to Sustainable Development in developing countries

GOALS AND FUNCTIONING OF THE CLEAN DEVELOPMENT MECHANISM

BACKUP

- **Problem:** Developing countries exhibit growing emissions but have no targets yet
- **Goal 1:** Foster clean growth by investing in environmentally sound technology
- **Goal 2:** The resulting investment should be leveraged for broader development benefits
- **Functioning:** Due to lower abatement costs, developed countries can meet targets more cost-efficiently



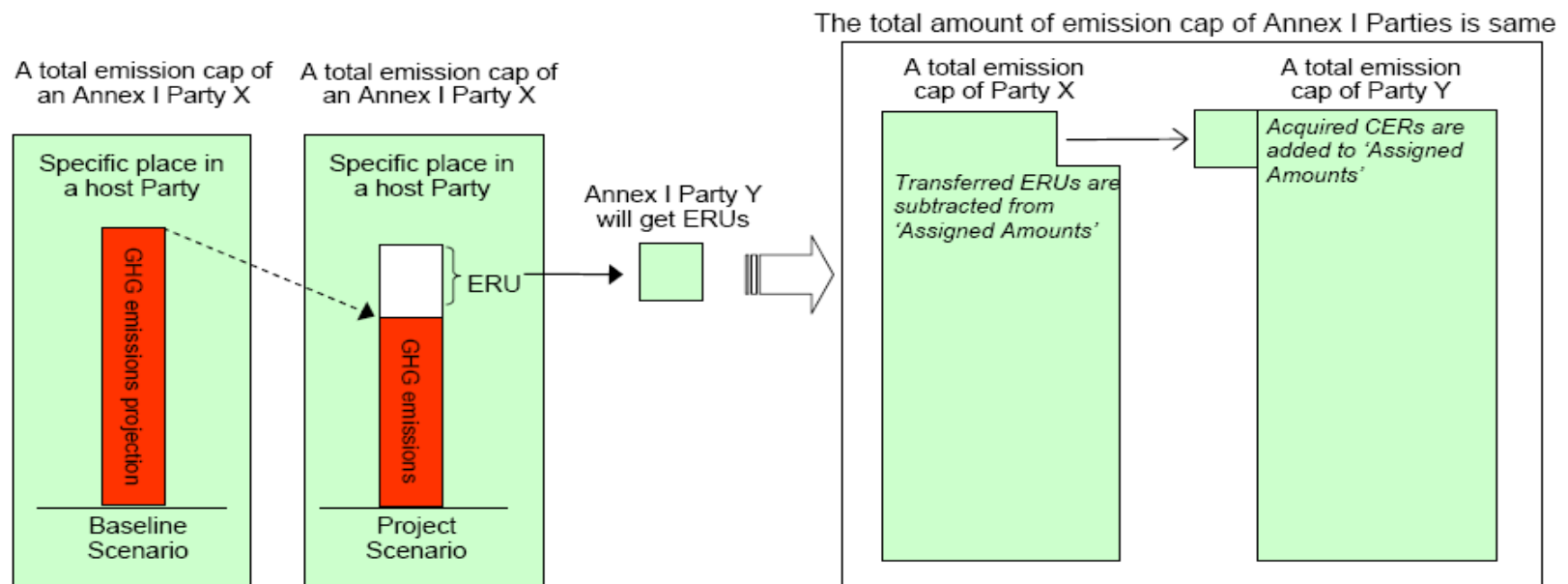
Source: CDM and JI in charts (version 6), IGES (2006)

The third mechanism „Joint Implementation“ promotes project-based emission reductions between Annex-I countries

REASONS FOR AND FUNCTIONING OF JOINT IMPLEMENTATION

BACKUP

- **Goal 1:** Provide Annex I countries with the possibility of generating additional certificates.
- **Goal 2:** Necessary foreign capital for the realization of these projects is attracted
- **Functioning:** The focus of this mechanism are economies in transition since they exhibit an inferior efficiency level and thus provide cheap mitigation opportunities



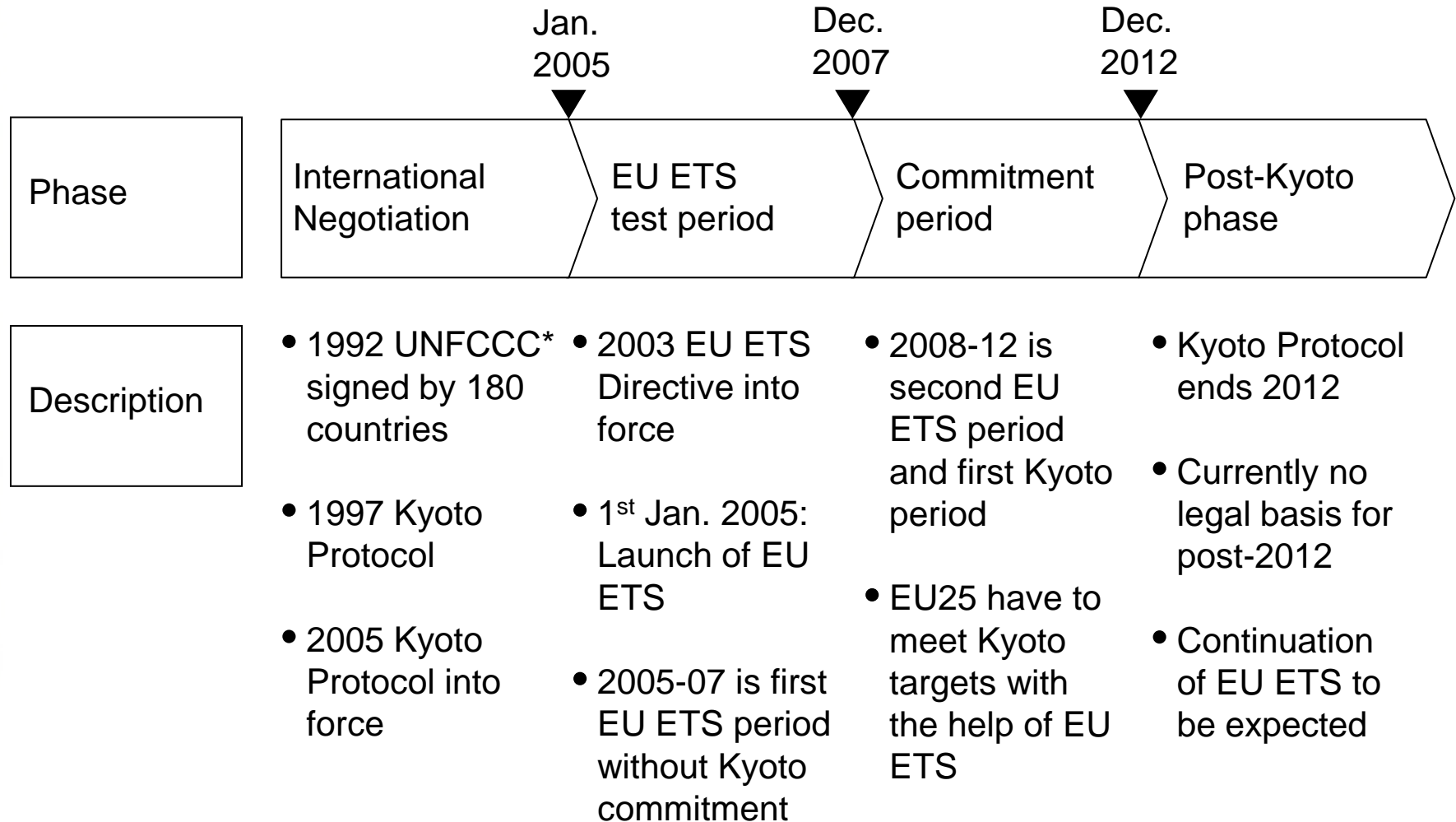
Source: CDM and JI in charts (version 6), IGES (2006)

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

The EU launched the EU ETS as part of its strategy to meet the Kyoto targets in 2012

HISTORICAL DEVELOPMENT AND FUTURE

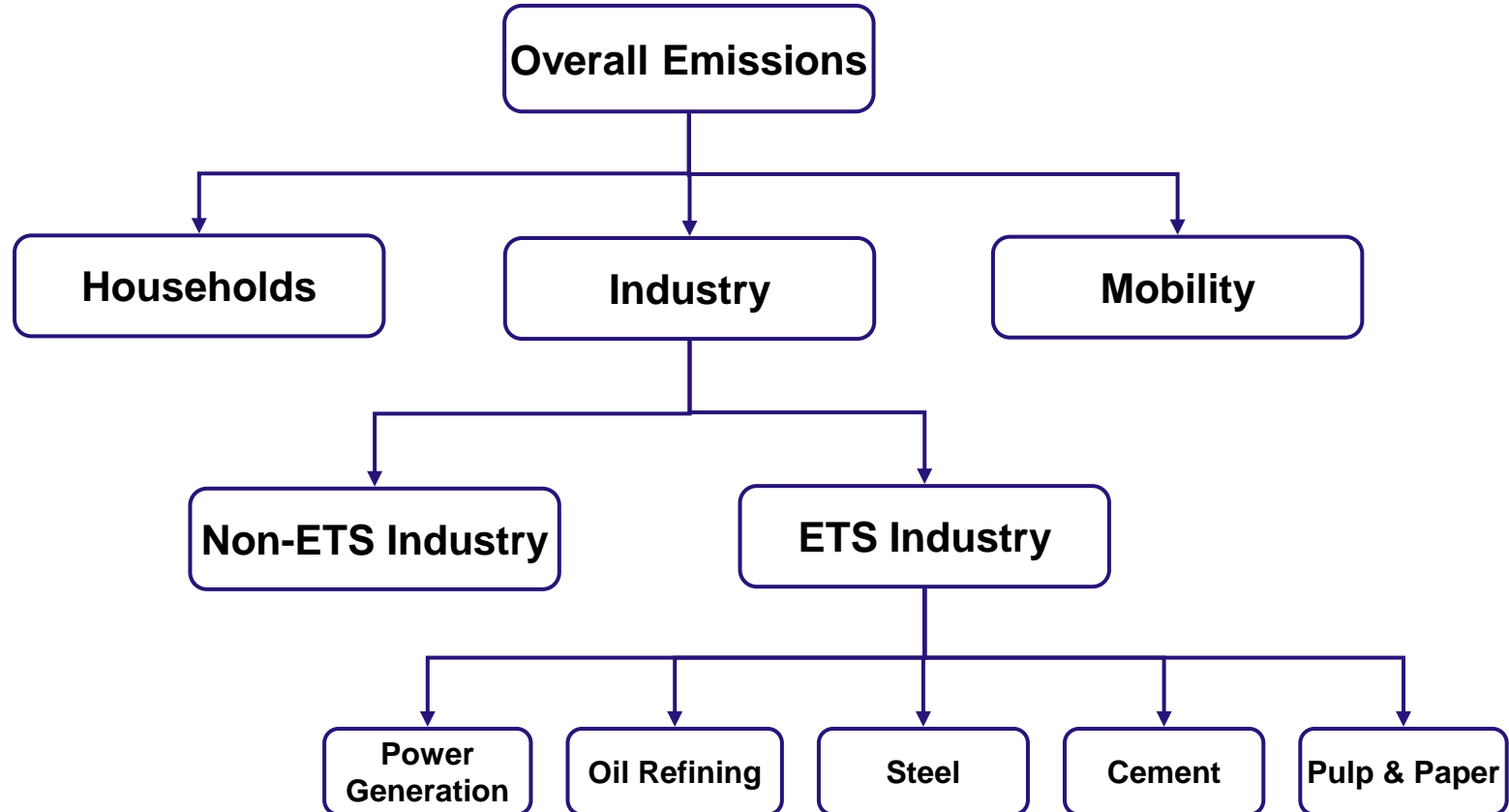


*UNFCCC: United Nations Framework Convention on Climate Change, Rio de Janeiro

Source: Pew Center 2005, own illustration

The EU ETS only covers a limited number of industrial sectors

STRUCTURE OF GERMAN EMISSION REDUCTION EFFORTS



EU Emission trading requires firms to have as many CO₂ allowances as they have CO₂ emissions

PRINCIPLE OF EMISSION TRADING

- The government sets an overall maximum of tons of CO₂ that can be emitted in a year. This amount is supposed to decrease over time.
- Firms in specific sectors are required to have an allowance for each ton of CO₂ they emit. Firms that emit without an allowance have to pay a fine and surrender the missing allowances in the following year.
- Each trading period the state can grant allowances to firms for free or auction them.
- Firms can trade allowances among themselves to account for under- or oversupply with allowances.
- Each year, firms have to surrender allowances to cover their actual emissions.

For each country, details of allowance distribution to companies are specified in so-called National Allocation Plans (NAP)

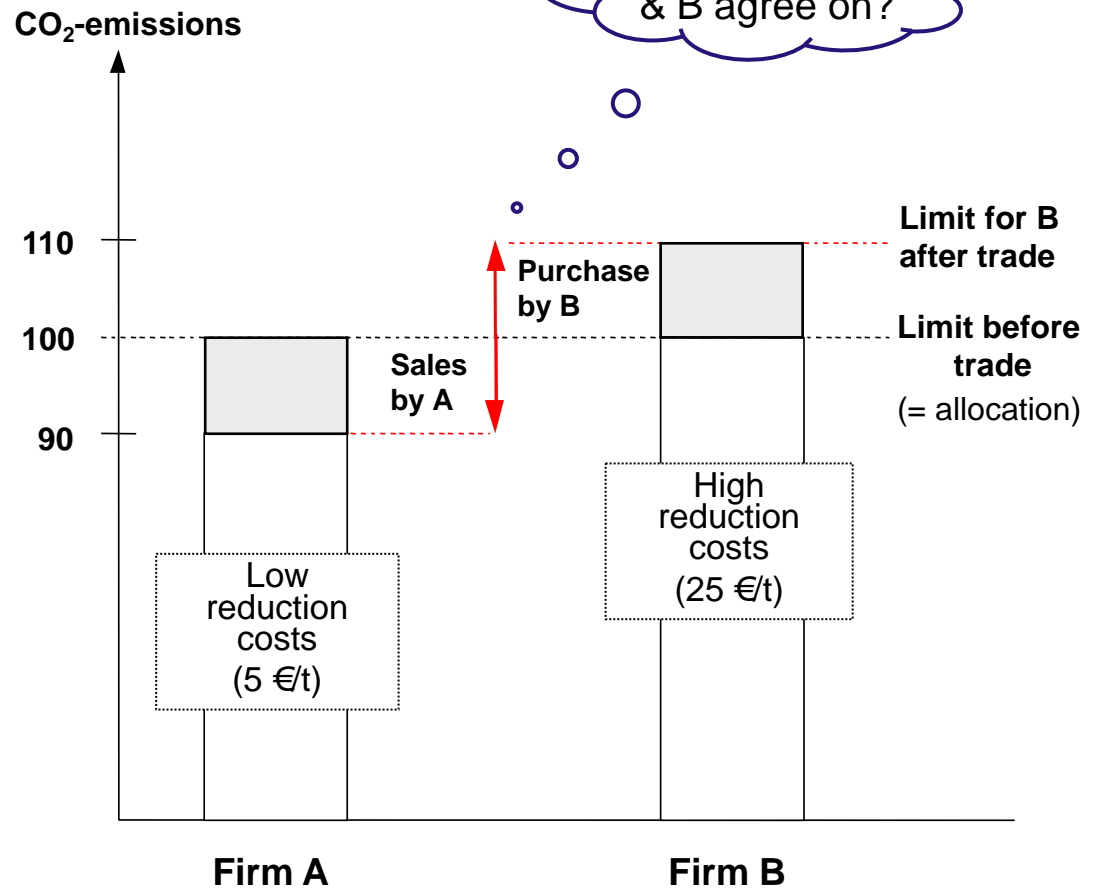
CHARACTERISTICS OF A NATIONAL ALLOCATION PLAN (NAP)

- An NAP describes for each trading period
 - How many allowances are allocated *in total* to all installations (macro plan)
 - By which rules the allowances are allocated to individual installations (micro plan)
- Each NAP has to fulfill certain criteria, especially conformity with the Kyoto protocol and consideration of new entrants
- The NAPs have to be submitted to the EU for approval

Basis of the emission trading scheme are different CO₂-reduction costs

FUNCTIONING OF THE EMISSION TRADING SYSTEM

1. Definition of target emission by state (here: 200)
2. Distribution of allowances to companies (here: 100 each to A and B)
3. Firm A plans to emit 100 tons of CO₂, B 110. Firm A has reduction costs of 5 €/t CO₂, B of 25 €/t CO₂
4. A implements CO₂ reduction measure and reduces 10 tons
5. Trade between A and B (trade of 10 allowances)
6. Monitoring and (maybe) fining by state



EXAMPLE CARBON TRADING



The CO₂ reduction costs vary significantly between industries and even firms...

AN ILLUSTRATIVE EXAMPLE FOR REDUCTION COSTS OF A GENERIC FIRM

In a reduction cost curve, all emission reduction possibilities are ordered according to increasing reduction costs per ton.

A firm will first pursue those reduction opportunities that are cheapest!

Reduction
costs per
ton of CO₂

Firm 1

Optimize
auxiliary
systems
(pumps...)

Optimized
Heat
Exchangers

Usage of
excess
heat

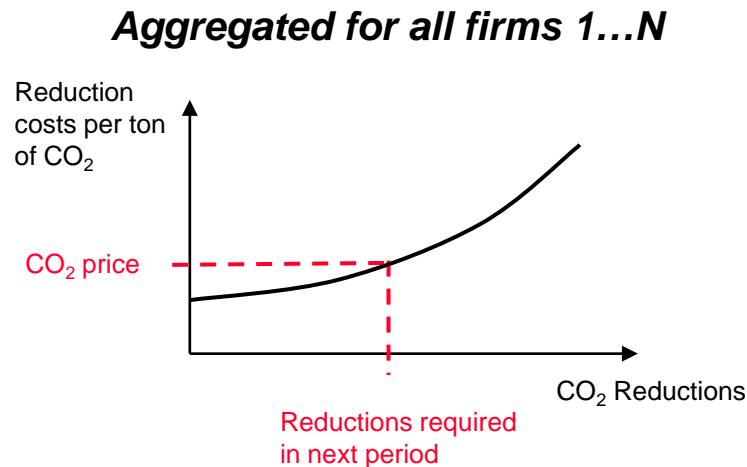
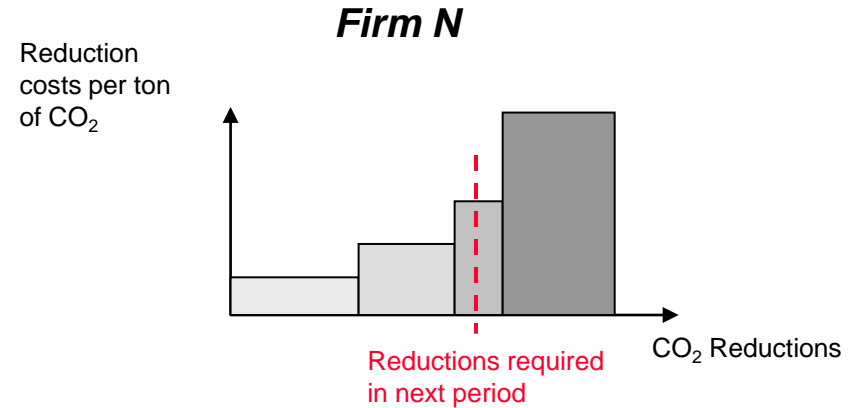
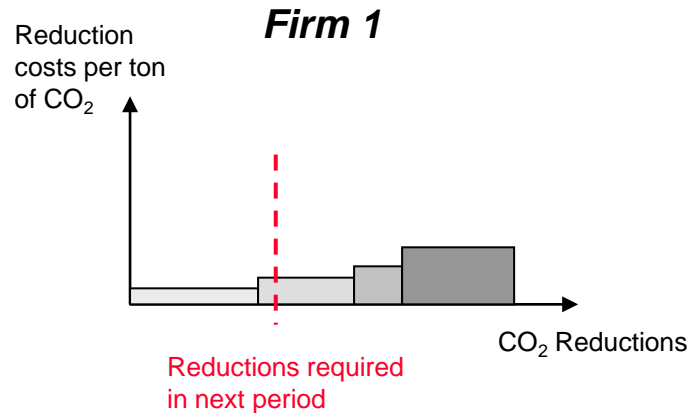
Burner
capable
of fuel
switch

New power
plant

CO₂ Reductions

... but they can be aggregated over the whole economy to yield an estimate of the future CO₂ price

DETERMINATION OF CO₂ PRICE BY AGGREGATING REDUCTION COST CURVES



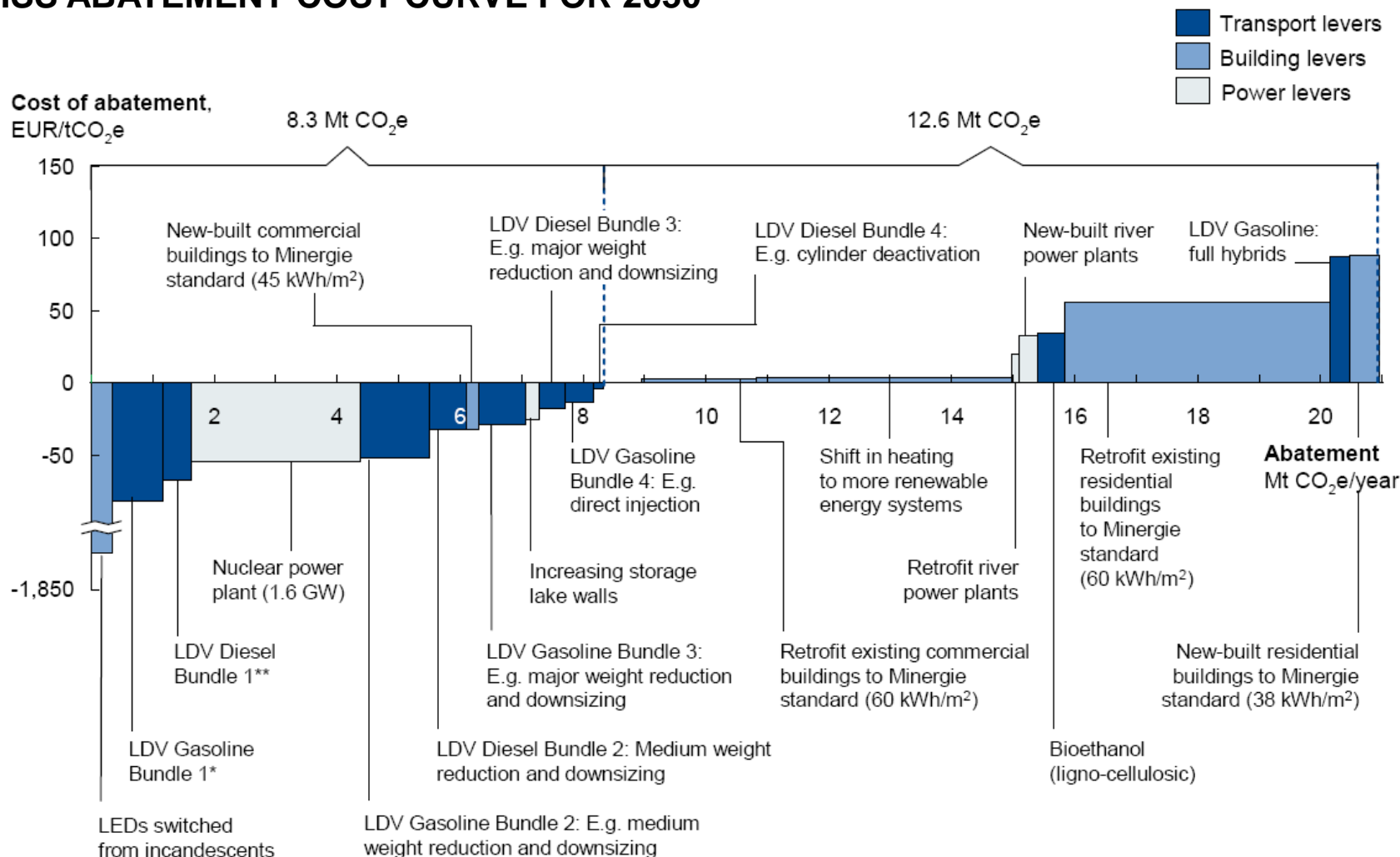
Unfortunately, estimating the CO₂ price is not that easy...

PRICE DEVELOPMENT FOR CO₂ ALLOWANCES



Source: Based on Point Carbon, 2008

SWISS ABATEMENT COST CURVE FOR 2030



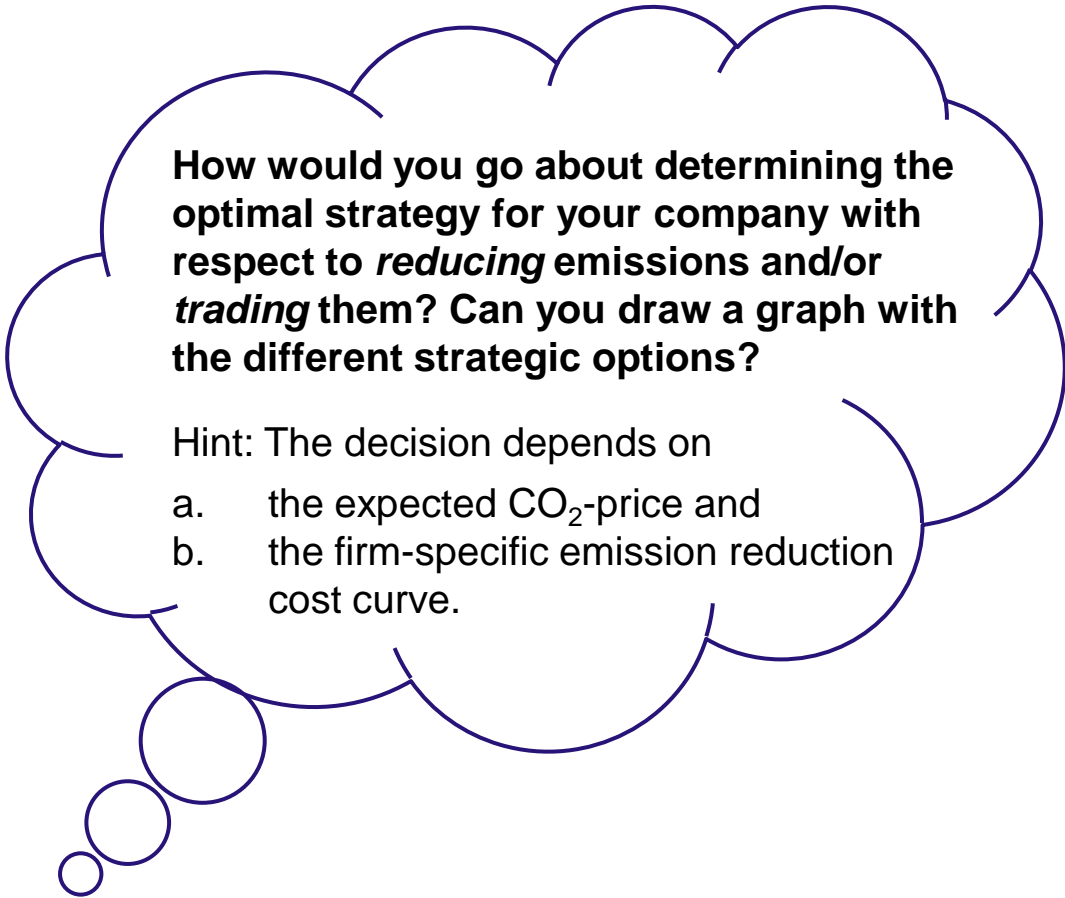
* LDV Gasoline Bundle 1: Including variable valve control, engine friction reduction (mild), low rolling resistance tires, tire pressure control system, mild weight reduction

Source: McKinsey (2009)

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- **Corporate Strategies in the EU ETS**
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

Imagine being the CEO of a big power utility



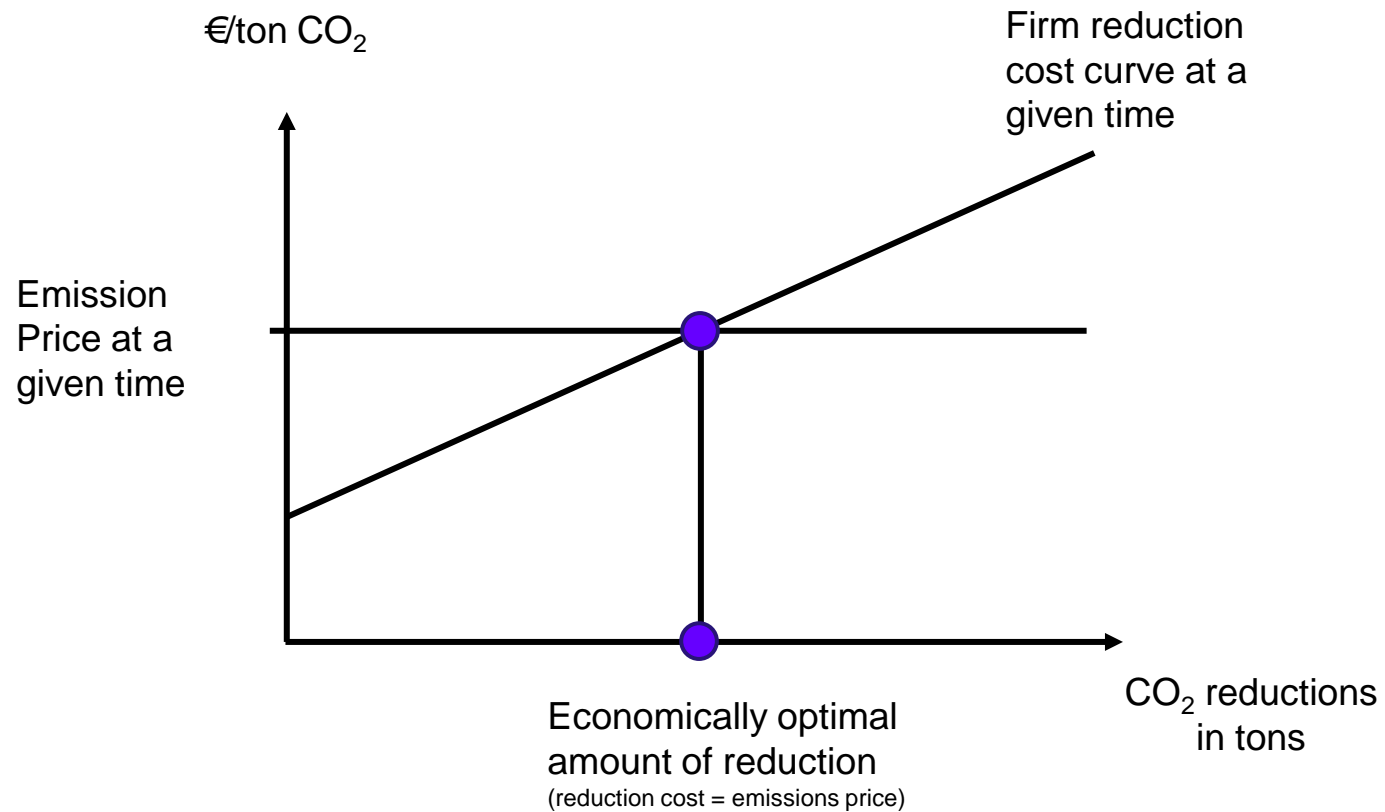
How would you go about determining the optimal strategy for your company with respect to *reducing* emissions and/or *trading* them? Can you draw a graph with the different strategic options?

Hint: The decision depends on

- a. the expected CO₂-price and
- b. the firm-specific emission reduction cost curve.

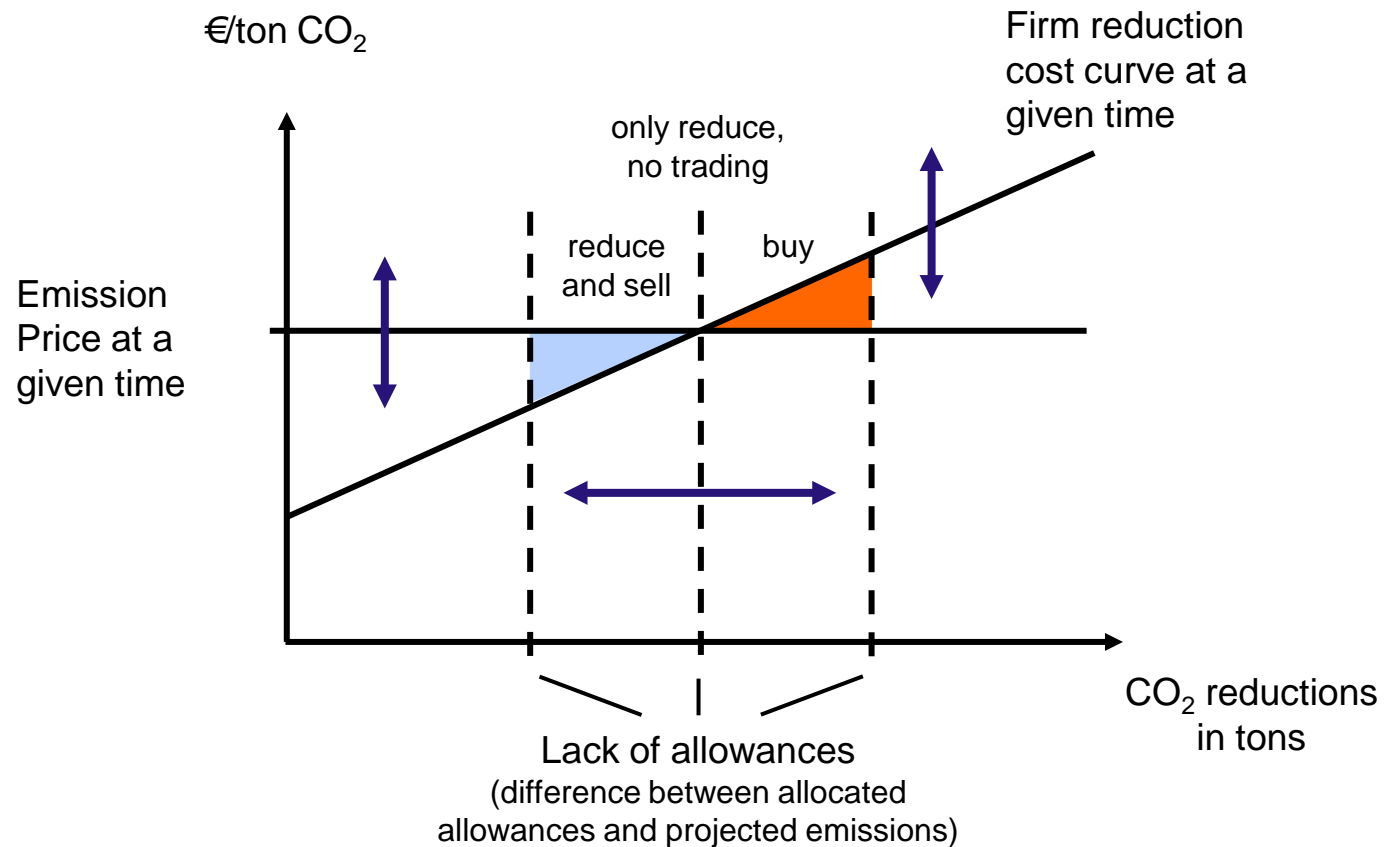
The ETS strategy of a firm depends on its reduction costs, the emission price and the amount of reductions required by the regulator...

REDUCTION DECISION



The ETS strategy of a firm depends on its reduction costs, the emission price and the amount of reductions required by the regulator...

REDUCTION DECISION



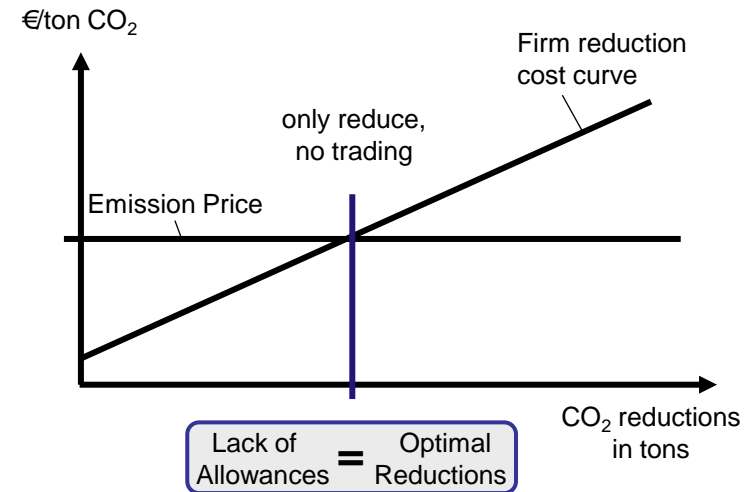
The companies under EU ETS face a continuum of possible strategies consisting of reducing and trading emissions certificates

BACKUP

FOUR MAIN STRATEGIES (1/2)

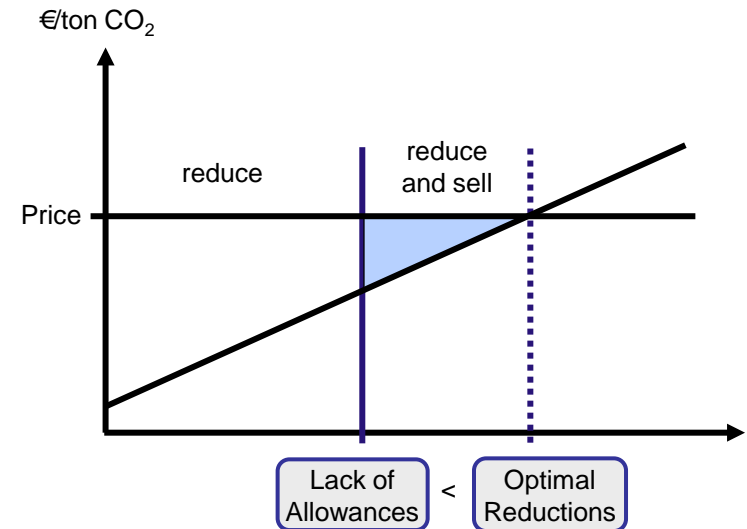
1. Reduce for compliance

The reduction cost for the compliance quantity is equal to the allowance price. Therefore, the firm reduces all emissions internally and does not trade.



2. Reduce more than compliance quantity and sell the surplus

The reduction cost for the compliance quantity is less than the allowance price. This means that the firm can reduce cheaper than its competitors and thus make a profit by selling additional reductions.



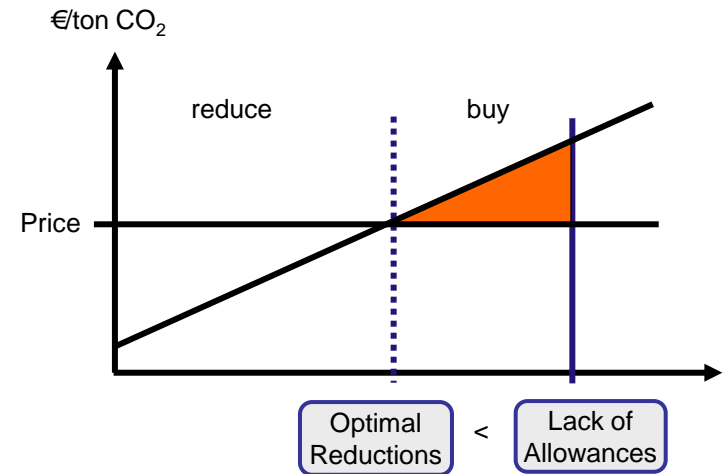
The companies under EU ETS face a continuum of possible strategies consisting of reducing and trading emissions certificates

BACKUP

FOUR MAIN STRATEGIES (2/2)*

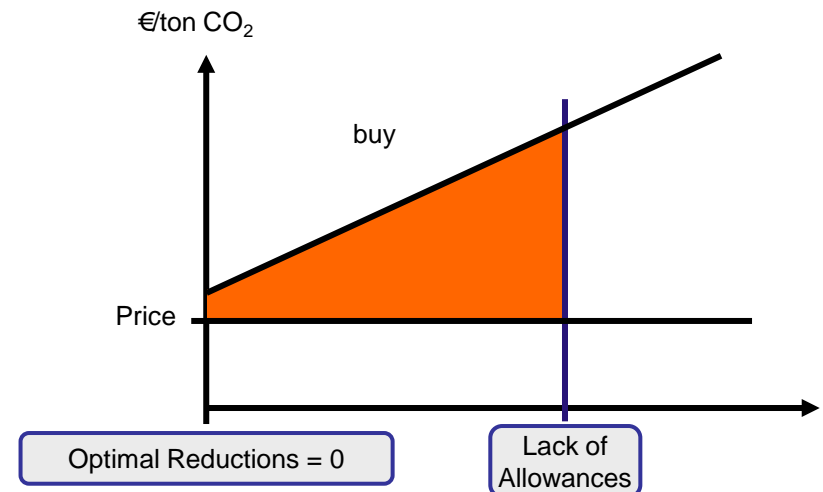
3. Reduce less than compliance and buy allowances

The reduction cost starts out lower than the allowance price but becomes higher than the allowance price at a quantity less than the compliance quantity. This means that beyond a certain point it is more profitable to buy allowances than to reduce internally.



4. Only buy allowances

The reduction cost is always higher than the allowance price. Therefore, the firm does not reduce internally but only acquires allowances on the market.

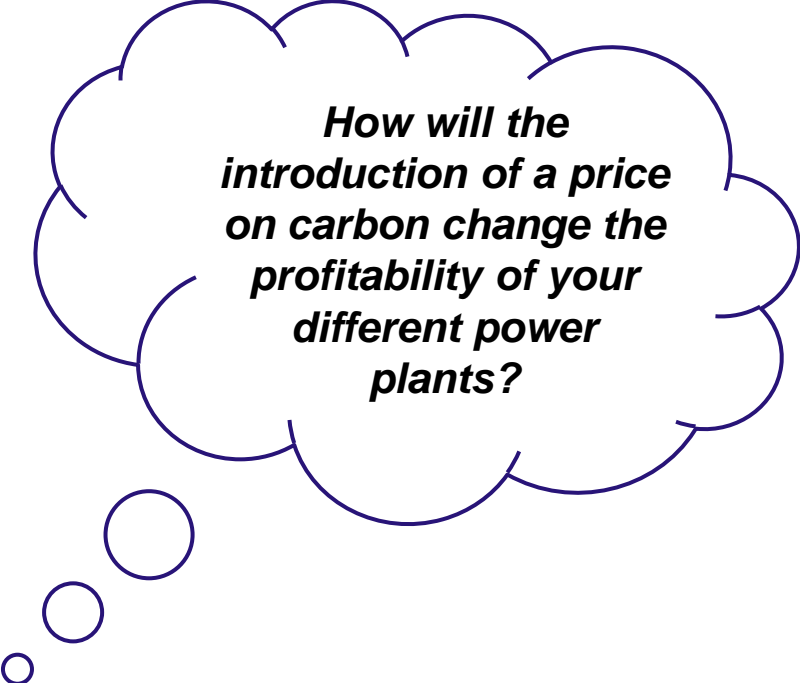


* A possible 5th strategy „only sell“ should not be possible since that would mean that the regulator gave the company more emission certificates than the company needs even without reducing anything!

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- **Potential Effects of the EU ETS on Value Chains**
- Discussion
- Connecting the EU ETS and the CDM

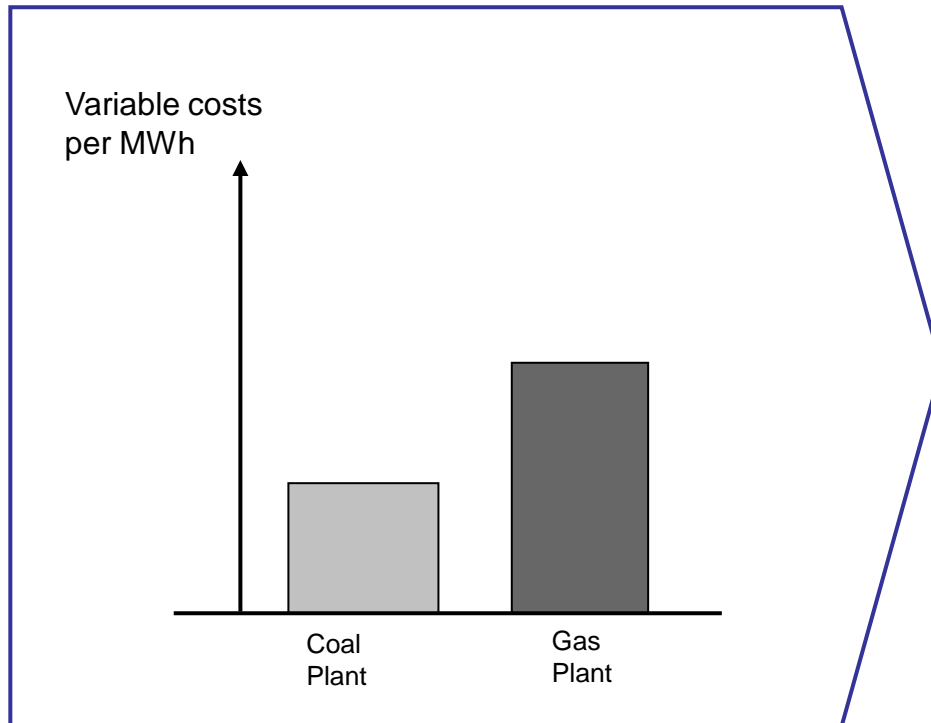
EXAMPLE POWER PLANTS



***How will the
introduction of a price
on carbon change the
profitability of your
different power
plants?***

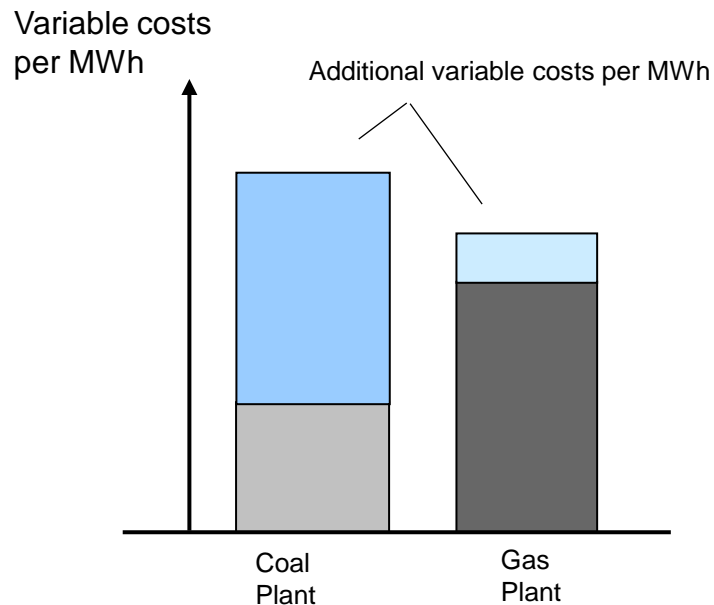
The carbon price changes profitability of power plants according to their carbon intensity

EU ETS EFFECT ON COAL AND GAS PLANTS



The carbon price changes profitability of power plants according to their carbon intensity

EU ETS EFFECT ON COAL AND GAS PLANTS



Effects:

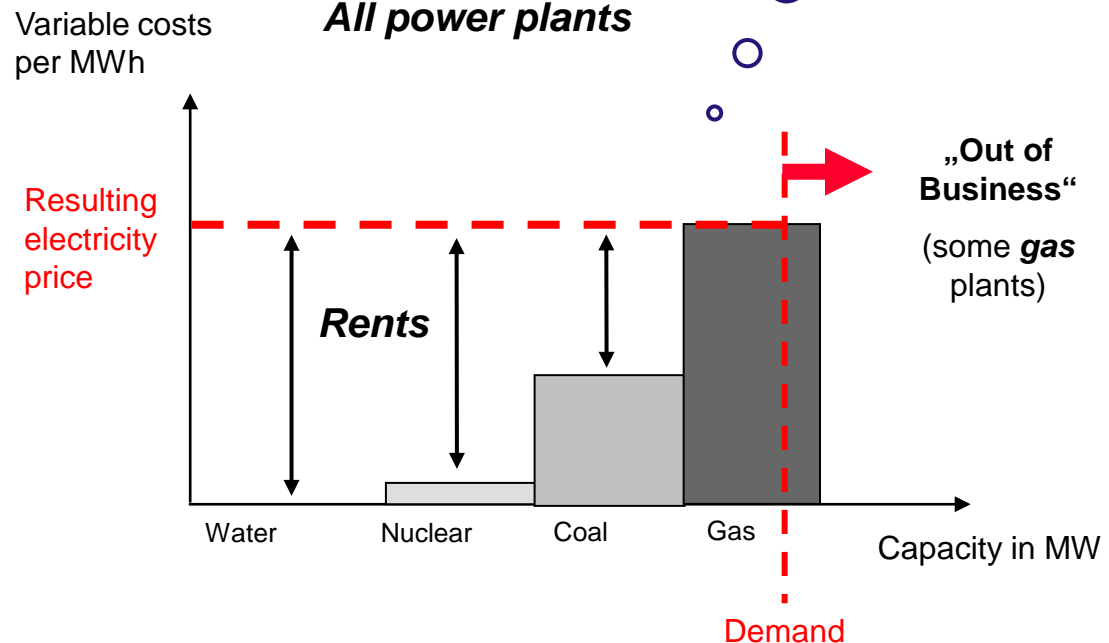
- Electricity price increases
- Impact on decisions about which existing power plants to operate and which type of new power plant to build
- Depending on allocation method, windfall profits can arise

Existing power plants are normally ranked according to their variable costs in the dispatching process

MERIT ORDER, RENTS AND ELECTRICITY PRICE

In a so-called **pool market** the price for electricity equals the variable costs of the marginal producer.

*The resulting order of profitability is called **merit order** and serves as a criterion for companies in their decision which power plants to run in function of demand.*



The carbon price changes profitability of power plants according to their carbon intensity

BACKUP

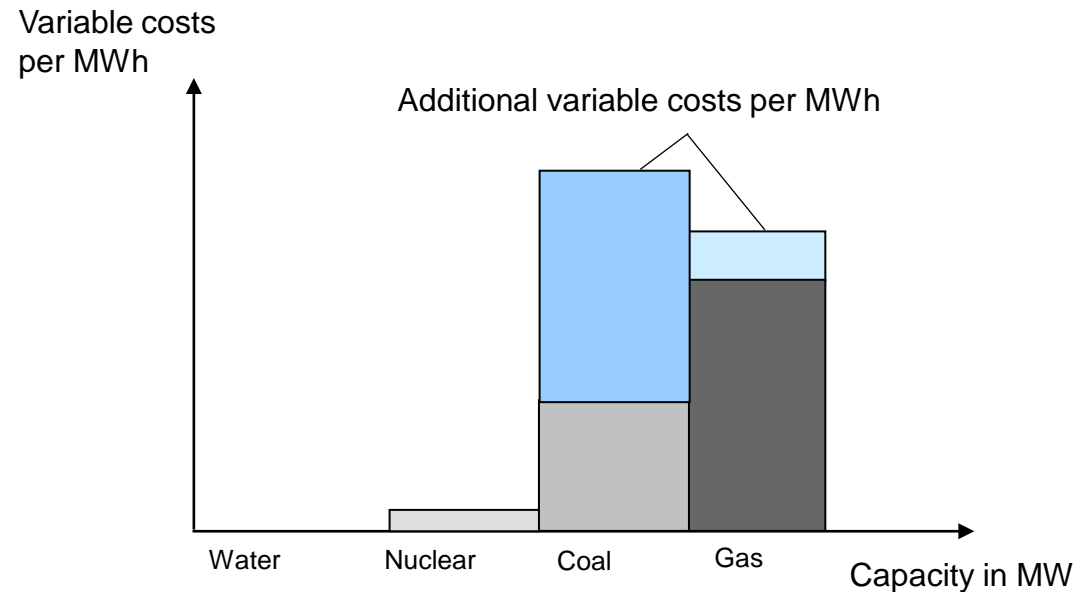
SWITCHES IN MERIT ORDER, CHANGES IN RENTS AND PRICE (1/2)

The variable costs of the different power generation options increase by the product of their carbon emissions per unit of energy (ton CO₂/MWh) and the CO₂ price (€/ton CO₂).

This results in

- a) An increase in electricity price since the marginal producer now has higher variable costs*
- b) A change in rents for the different options*
- c) Some cases in a switch in merit order if the variable costs of the different options changed significantly*

All power plants



The carbon price changes profitability of power plants according to their carbon intensity

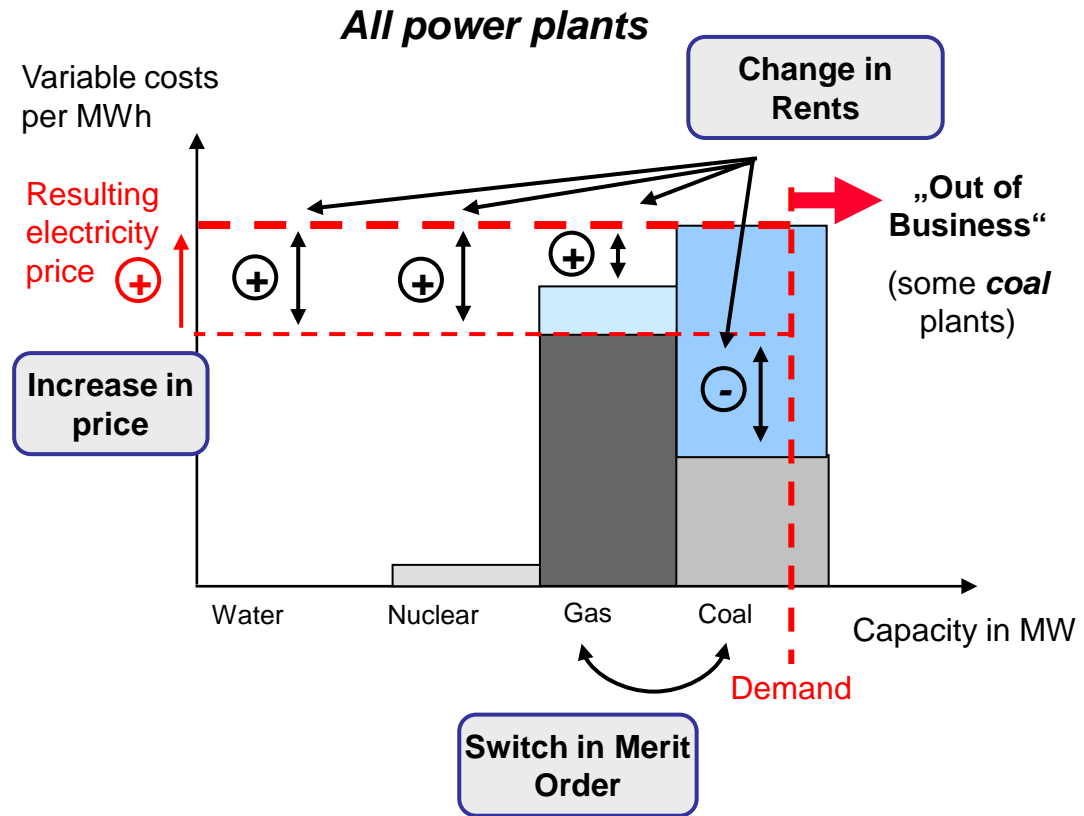
BACKUP

SWITCHES IN MERIT ORDER, CHANGES IN RENTS AND PRICE (2/2)

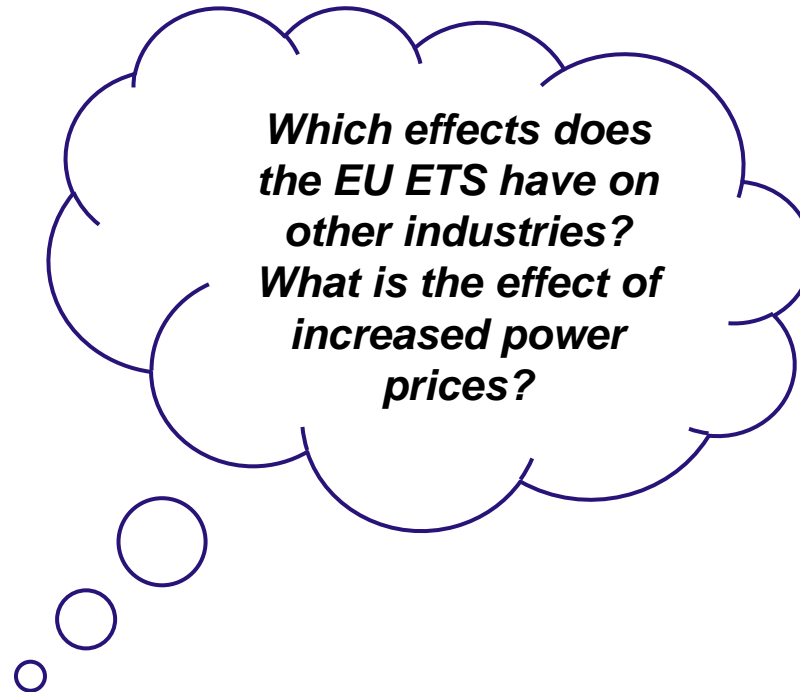
The variable costs of the different power generation options increase by the product of their carbon emissions per unit of energy (ton CO₂/MWh) and the CO₂ price (€/ton CO₂).

This results in

- Some cases in a switch in merit order if the variable costs of the different options changed significantly
- An increase in electricity price since the marginal producer now has higher variable costs
- A change in rents for the different options



EXAMPLE VALUE CHAIN EFFECTS

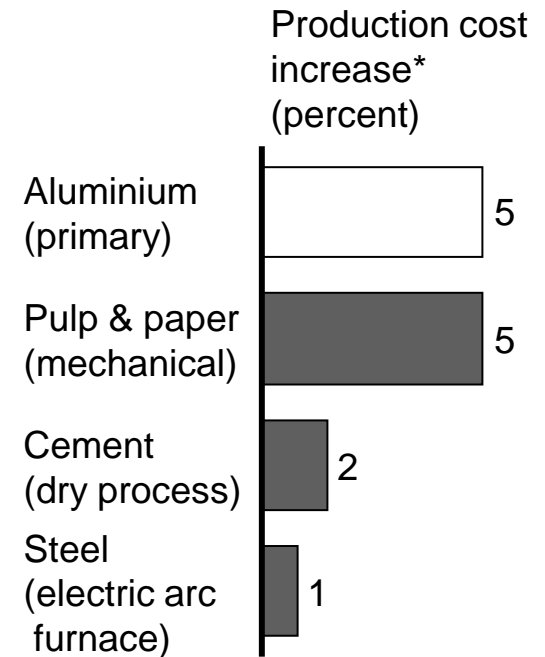
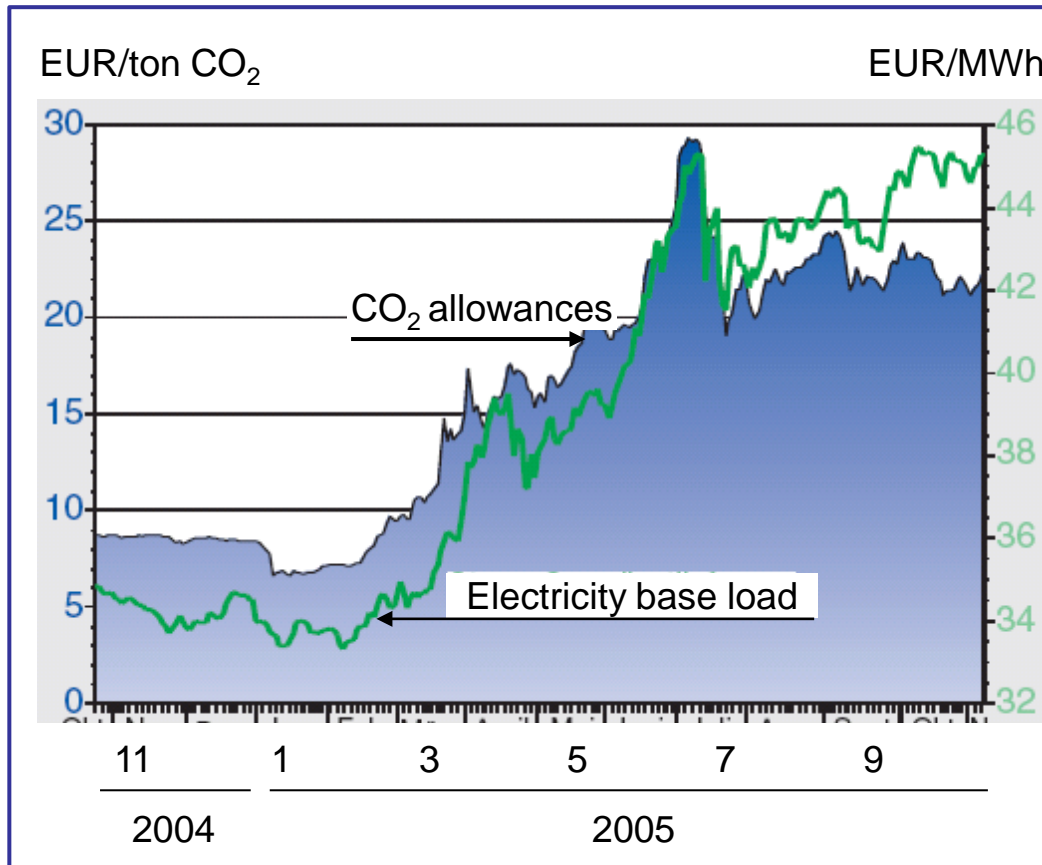


Increase in electricity price from CO₂ cost causes increased downstream production cost

ELECTRICITY PRICE AND EFFECTS ON VALUE CHAINS

EXAMPLE ELECTRICITY PRICE

Industry included in the Emission trading scheme




* Only indirect effect from electricity price increase due to European Emission Trading (assuming 10 EUR/ton CO₂ allowance price), only selected production processes with high cost effect

Source: EEX, Wirtschaftsvereinigung Stahl, International Energy Agency (IEA), Reinaud 2004, Hübner 2007

AGENDA

- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

CONCLUDING THOUGHTS



Seen from both policy and business perspective, what do you think are the advantages and the disadvantages of the EU ETS?

Summarizing, what are Pros and Cons of the EU ETS ?

ROUGH ASSESSMENT OF ADVANTAGES AND DISADVANTAGES OF THE EU ETS

Advantages

- **Emission cap:** clear path for reductions of emissions
- **Flexibility:** Companies can choose their reduction and/or trading strategy
- **Cost efficiency:** carbon price reflects mitigation cost (market based regulation)
- **Compatibility:** global extension through connection with other systems possible

Disadvantages

- **Competitive disadvantage:** Increase in production cost cause industries to move production outside EU. System only functions in a global trading market.
- **Susceptibility to bargaining power:** Lobby groups can and are influencing the system heavily (the cost efficiency advantage may not hold any more in economic terms)
- **Transaction costs:** Monitoring, Account management, Trading facility...
- **Planning reliability:** Legal constraints only until 2012, only short allocation periods.
- **Windfall profits:** Power generation sector passes prices on despite free allowances

OUTLOOK ON EU ETS POST 2012

- Next trading period from 2013 to 2020
- Reduction goal of -20% (based on 1990 level) or -30% if post-Kyoto agreement ratified
- Entry of new industries most likely: chemical industry, aviation and shipping
- Auctioning of permits, e.g. for energy production facilities up to 100%
- Compensation scheme for energy intensive, export-oriented industries
- Inclusion of offset certificates (CDM) only from countries which have ratified post-Kyoto protocol

AGENDA

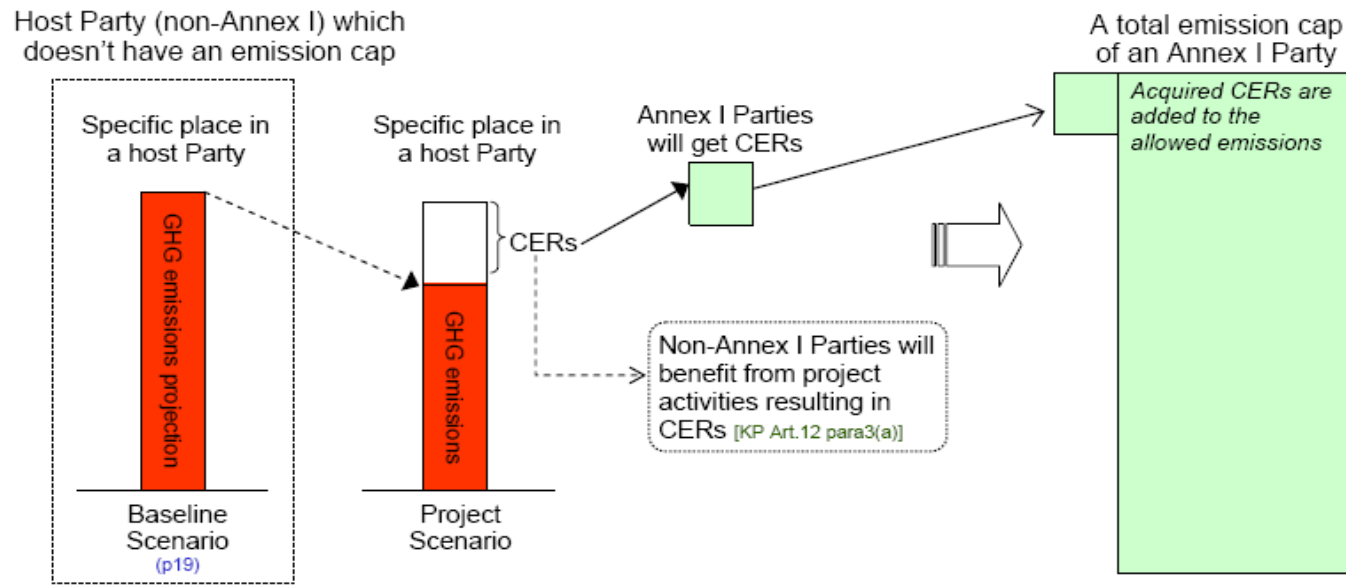
- Introduction to Kyoto Protocol
- Introduction to EU ETS
- Corporate Strategies in the EU ETS
- Potential Effects of the EU ETS on Value Chains
- Discussion
- Connecting the EU ETS and the CDM

The CDM aims at achieving both cost-efficient emission reductions and at contributing to Sustainable Development in developing countries

GOALS AND FUNCTIONING OF THE CLEAN DEVELOPMENT MECHANISM

BACKUP

- **Problem:** Developing countries exhibit growing emissions but have no targets yet
- **Goal 1:** Foster clean growth by investing in environmentally sound technology
- **Goal 2:** The resulting investment should be leveraged for broader development benefits
- **Functioning:** Due to lower abatement costs, developed countries can meet targets more cost-efficiently

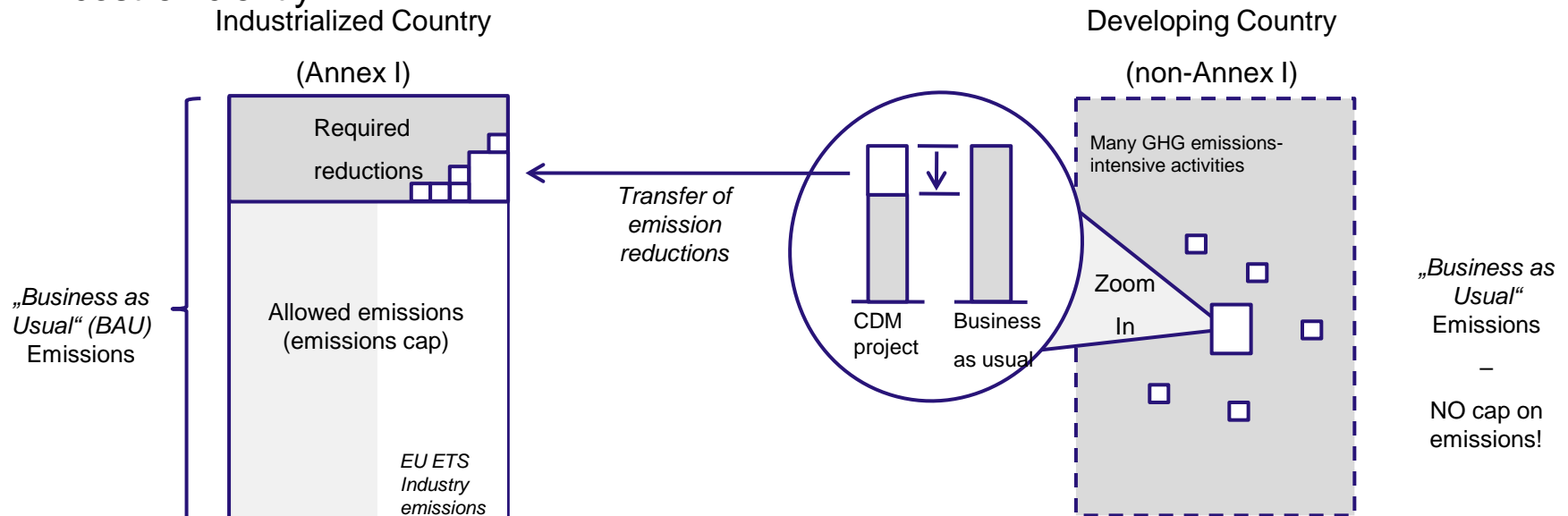


Source: CDM and JI in charts (version 6), IGES (2006)

The CDM aims at achieving both cost-efficient emissions reductions and at contributing to Sustainable Development in developing countries

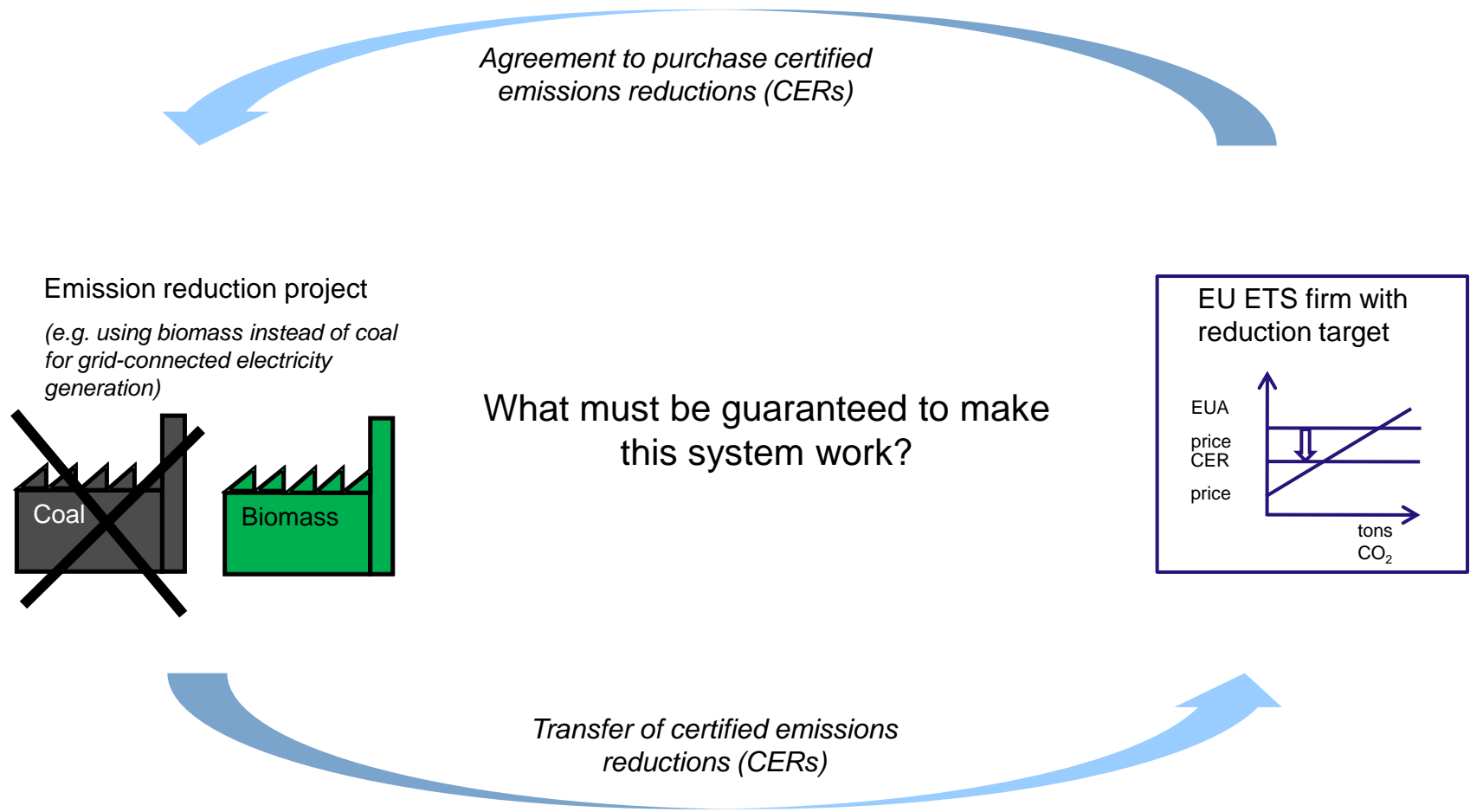
PROBLEM, GOAL AND FUNCTIONING OF THE CLEAN DEVELOPMENT MECHANISM

- Problem: Developing countries exhibit growing emissions but have no targets yet
- Goal 1: Foster clean growth by investing in environmentally sound technology
- Goal 2: The resulting investment should be leveraged for broader development benefits
- Functioning: Due to lower abatement costs, developed countries can meet targets more cost-efficiently



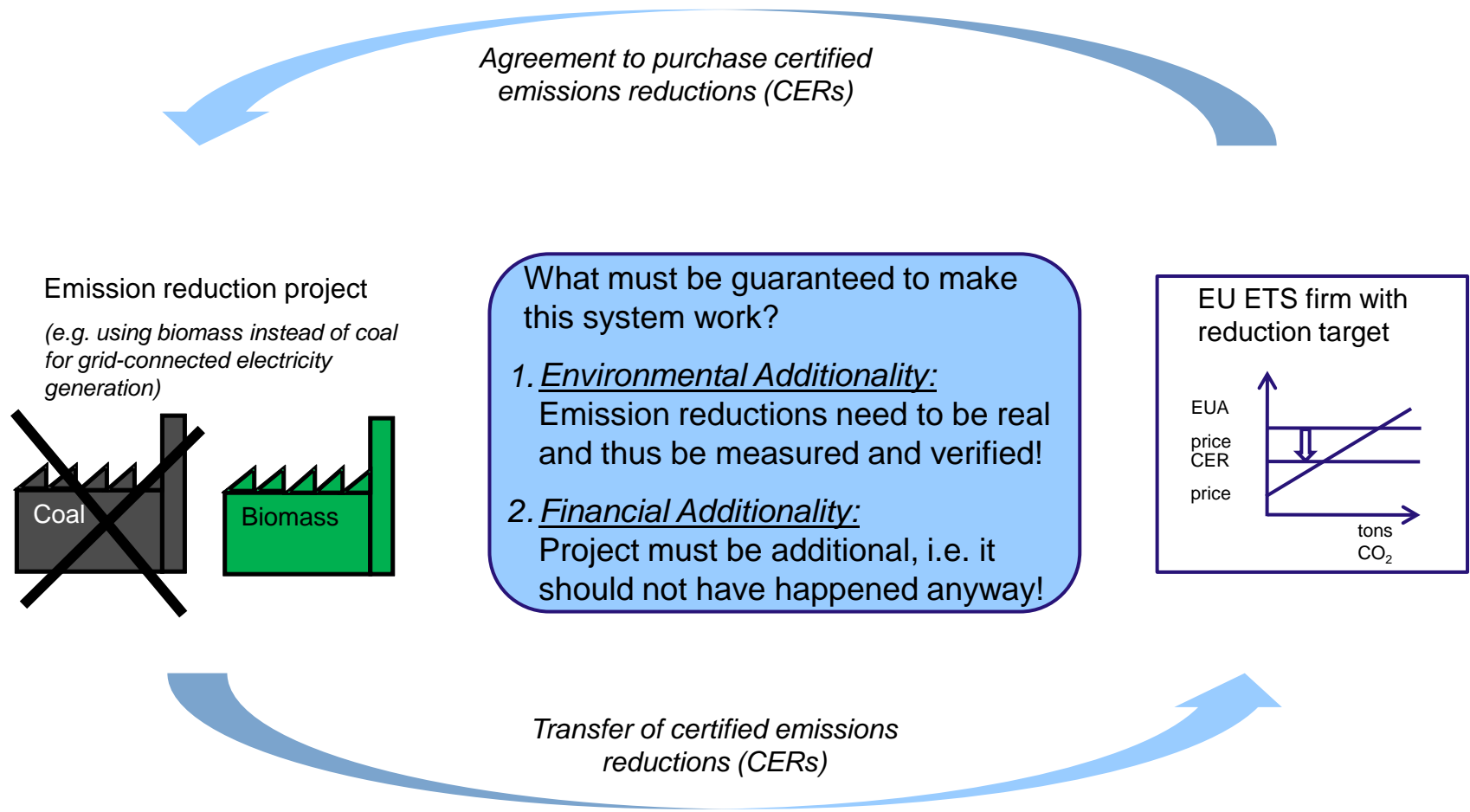
It is of paramount importance to guarantee the integrity of the whole Kyoto system

EXAMPLE OF CDM PROJECT



It is of paramount importance to guarantee the integrity of the whole Kyoto system

EXAMPLE OF CDM PROJECT



By assessing a project's emissions against a baseline scenario, environmental integrity of the system is pursued

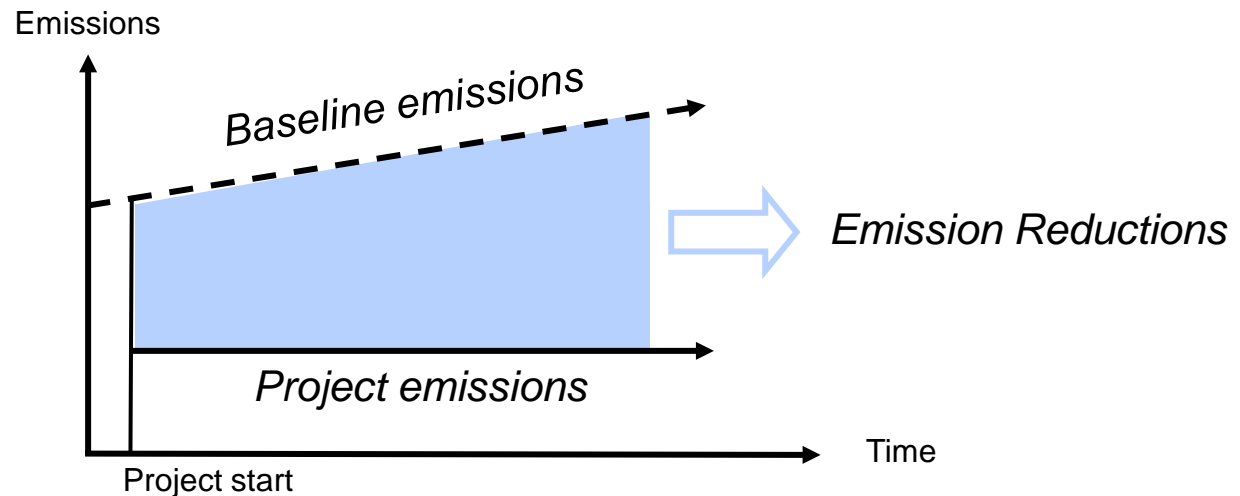
GENERATION OF CERs

Baseline

- How many GHG emissions would occur in the absence of the proposed project activity?
- Methodology for assessing baseline is needed

Project Emissions

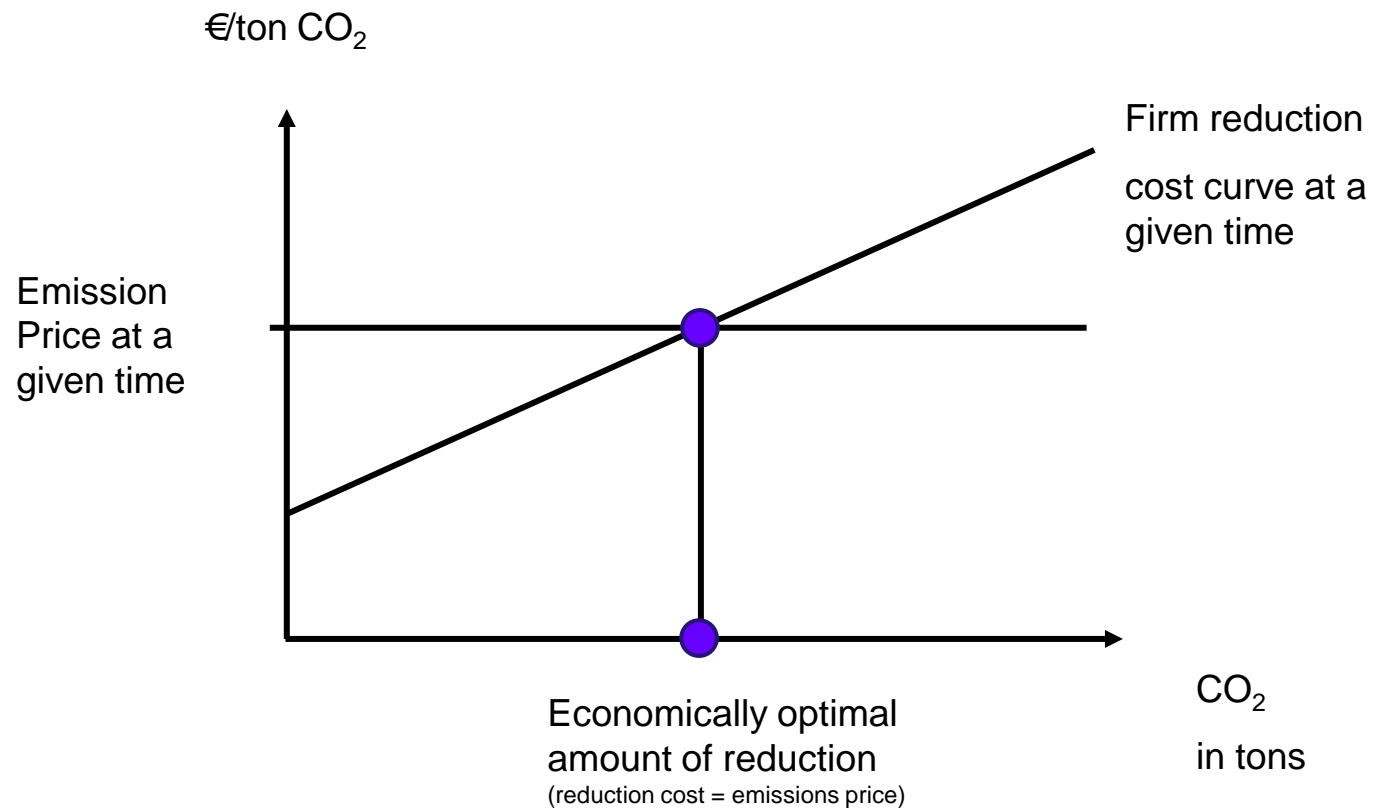
- How much CO₂ will be emitted after the project has been implemented?
- This has to be measured over time according to monitoring methodology



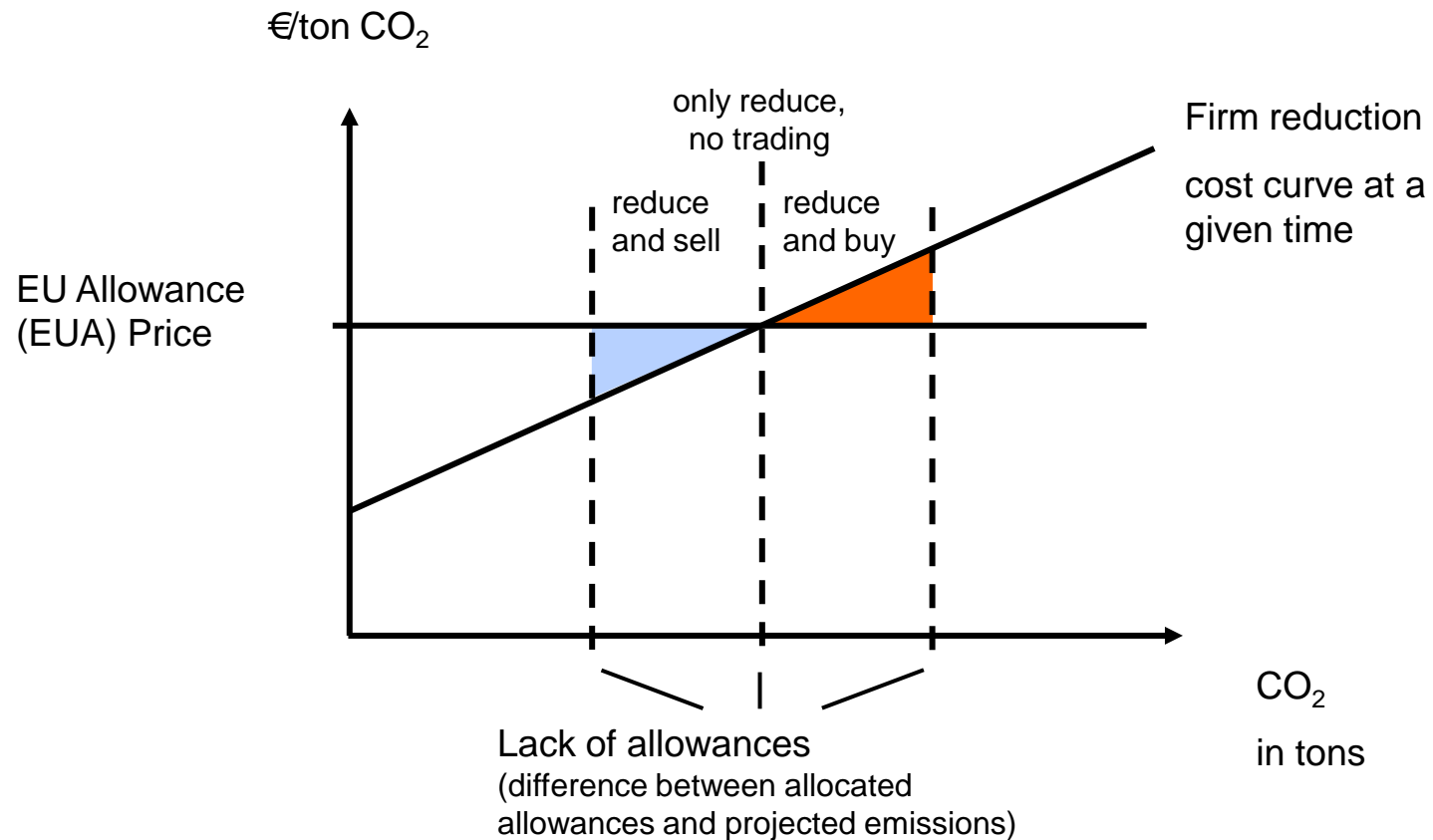
Emissions Reductions

- How many emissions does the project activity reduce with respect to the baseline scenario?
- This amount results in Certified Emission Reductions (CER) tradable in the market

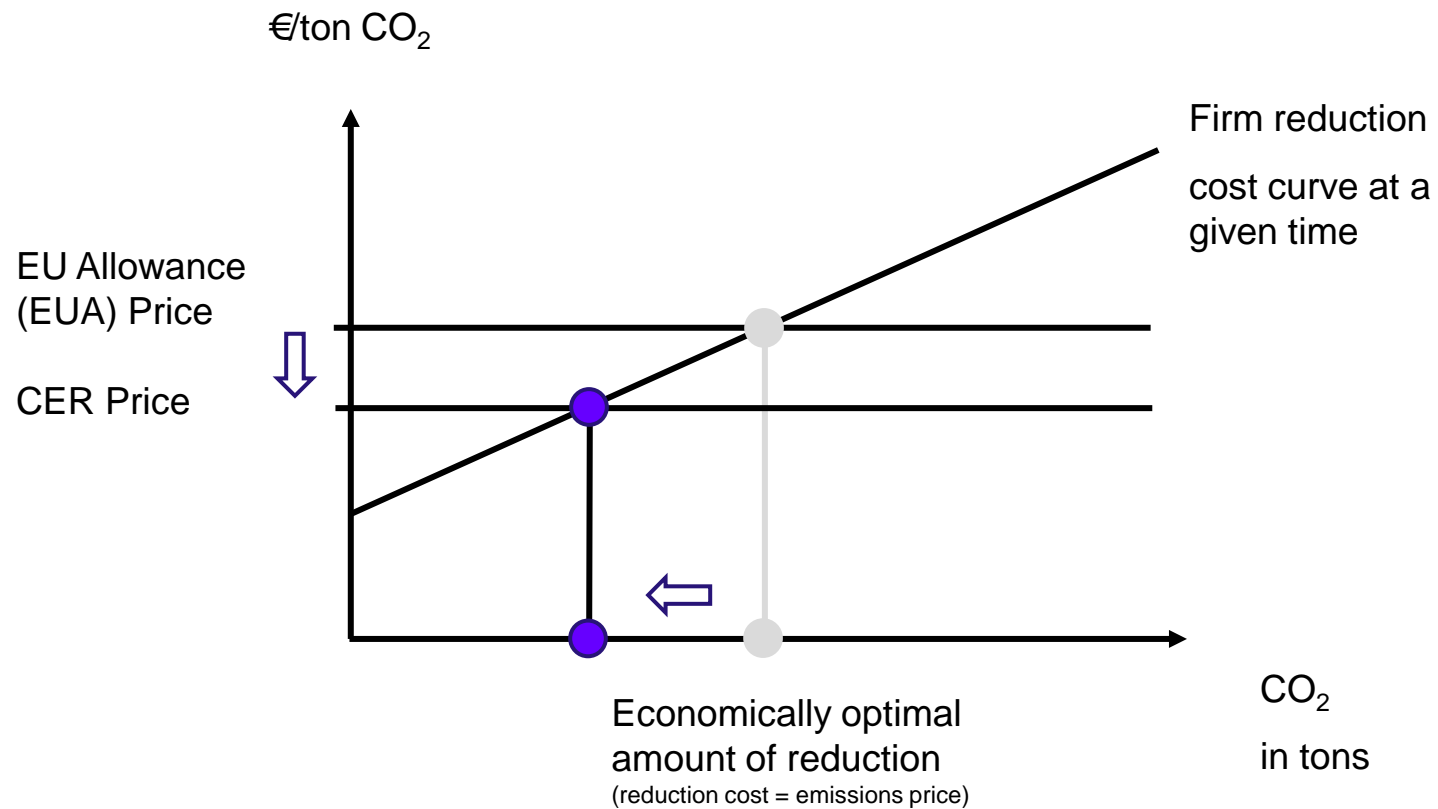
The CDM is driven by compliance considerations of industrialized country governments or firms



The CDM is driven by compliance considerations of industrialized country governments or firms

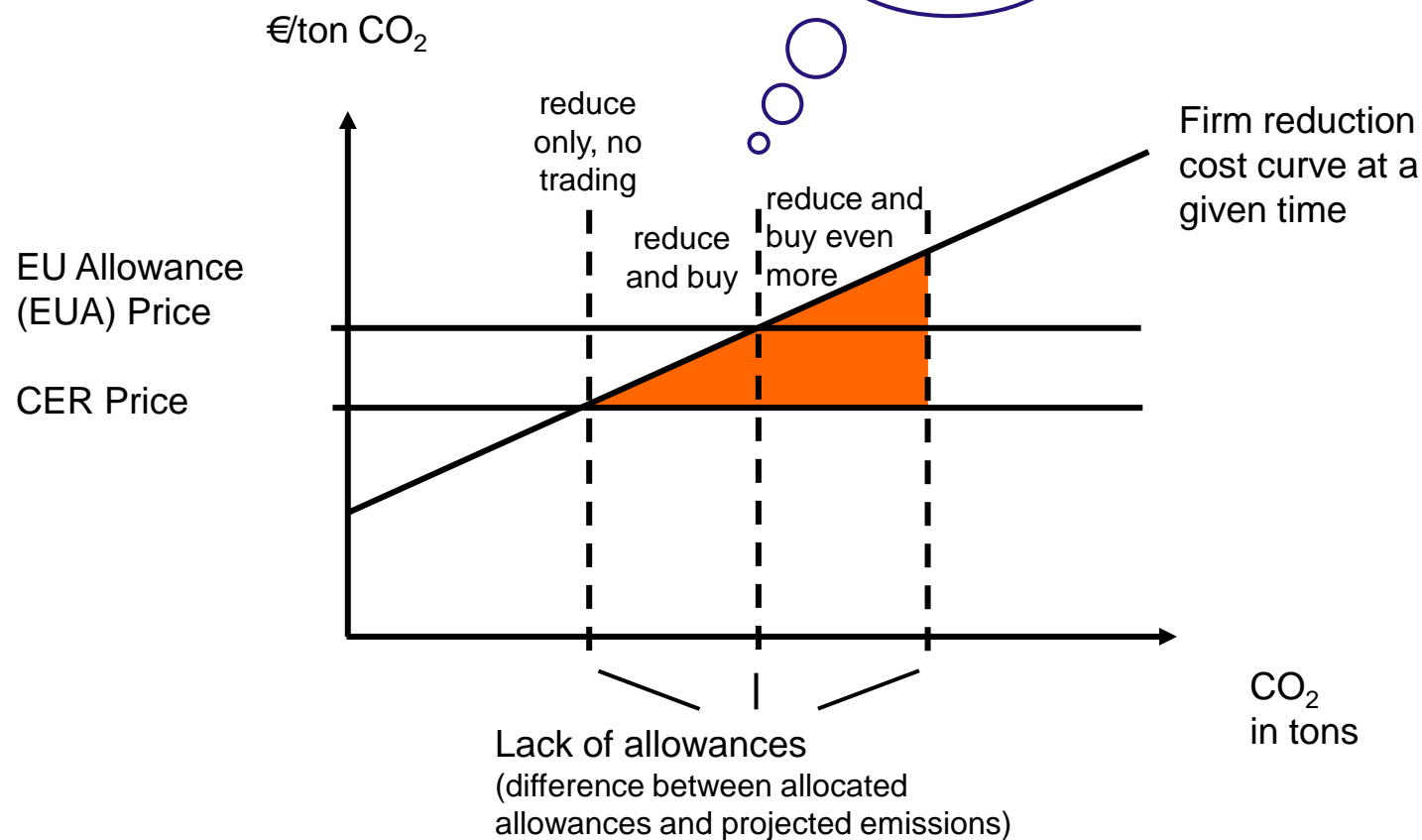


The CDM is driven by compliance considerations of industrialized country governments or firms



The CDM is driven by compliance considerations of industrialized country governments or firms

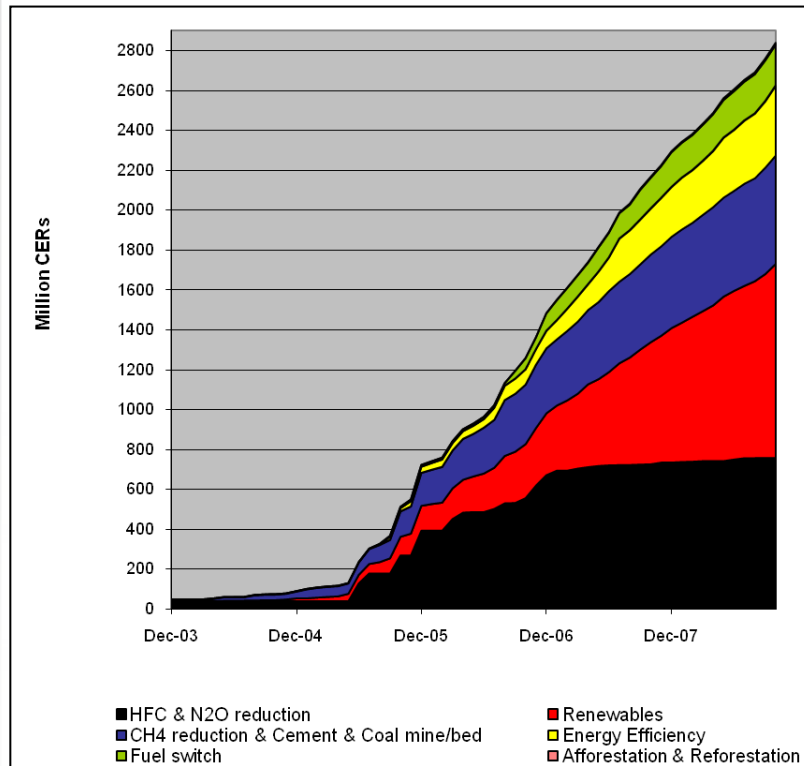
- Obtaining CERs more difficult than buying EUAs
- Limits on use of CERs
- More risks



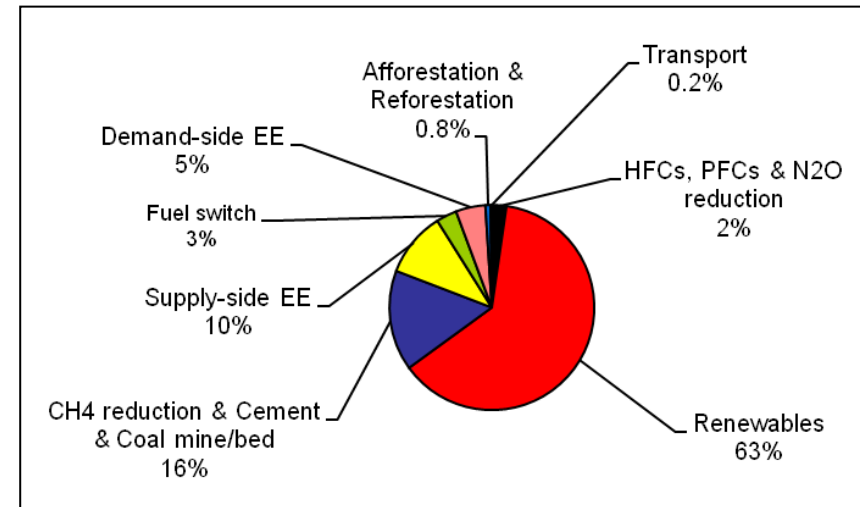
The CDM market develops in a very dynamic way in quantity and the distribution of project types

RECENT MARKET DEVELOPMENT (1/2)

Growth of total expected accumulated 2012 CERs



Number (%) of CDM projects in each category



Source: CDM Pipeline, www.cd4cdm.org, UNEP Risoe Center (accessed Nov 2008)

The regional distribution is unbalanced in favour of the big emerging economies that currently attract investment in many other areas as well

RECENT MARKET DEVELOPMENT (2/2)

